Program Curriculum for Master of Science in Mechanical Engineering

1st YEAR

1st Level							
Course Code	**Course Name**	**Prerequisites**	**Credit Units**	**Weekly Contact Hours**			
				Lec	**Lab**	**Tut**	**Sum**
ME 700	Engineering Mathematics		3	3	-	-	3
ME 701	Experimental Methods in Mechanical Engineering		3	3	-	-	3
ME 7XX	Elective I	As per Course	3	3			3
Sum	**3 Courses**		**9**	**9**	**-**	**-**	**9**
2nd Level							
Course Code	**Course Name**	**Prerequisites**	**Credit Units**	**Weekly Contact Hours**			
				Lec	**Lab**	**Tut**	**Sum**
ME 702	Modeling and Simulation in Mechanical Engineering		3	3	-	-	3
ME 7XX	Elective II	As per Course	3	3			3
ME 7XX	Elective III	As per Course	3	3			3
Sum	**3 Courses**		**9**	**9**			**9**

2nd YEAR

3rd Level							
Course Code	Course Name	Prerequisites	Credit Units	Weekly Contact Hours			
				Lec	Lab	Tut	Sum
ME 7XX	Elective IV	As per Course	3	3			3
ME 798	Project	As per Course	3		6		6
Sum	**2 Courses**		**6**	**3**	**6**		**9**
4th Level							
Course Code	Course Name	Prerequisites	Credit Units	Weekly Contact Hours			
				Lec	Lab	Tut	Sum
ME 7XX	Elective V	As per Course	3	3			3
Exit point: Higher Diploma in Mechanical Engineering (Total of 24 Credit hours which does not include the ME798 course in the previous semester)							
ME 798	Project		3		6		6
Sum	**2 Courses**		**6**		**6**		**9**
Total	**9 courses**		**30**	**24**	**12**		**36**

1- Renewable Energy Track: Elective Courses

CODE	Course Name	Prerequisite	Credit Units	Weekly Contact Hours			
				Lec.	Lab.	Tut.	Sum
ME711	Introduction to renewable energy Engineering		3	2	1		3
ME712	Energy Conversion	ME 711	3	3			3
ME713	Wind energy	ME 711	3	3			3
ME714	Photovoltaic Energy Systems	ME 711	3	3			3
ME715	Concentrated Solar Energy Plants	ME 711	3	3			3
ME716	Renewable Energy Economics and Planning	ME 711	3	3			3
ME717	Geothermal energy	ME 711	3	3			3

2- Thermofluid Sciences Track: Elective Courses

CODE	Course Name	Prerequisite	Credit Units	Weekly Contact Hours			
				Lec.	Lab.	Tut.	Sum
ME731	Advanced Thermodynamics		3	3			3
ME732	Advanced Fluid Mechanics	ME 731	3	3			3
ME733	Advanced Heat Transfer	ME 731	3	3			3
ME734	Advanced Computational Fluid Dynamics Methods	ME 731	3	3			3
ME735	Combustion Emissions and Control	ME 731	3	3			3
ME736	Thermal Design of Heat Exchangers	ME 731	3	3			3
ME737	Desalination and Water Purification	ME 731	3	3			3

3- Materials and Manufacturing Engineering Track: Elective Courses

CODE	Course Name	Prerequisite	Credit Units	Weekly Contact Hours			
				Lec.	Lab.	Tut.	Sum
ME750	Additive Manufacturing Engineering		3	3			3
ME751	Computer Integrated Manufacturing	ME750	3	3			3
ME752	Deformation, Fatigue and Fracture of Engineering Materials	ME750	3	3			3
ME753	Advanced Machining Processes	ME750	3	3			3
ME754	Advanced Corrosion Engineering	ME750	3	3			3
ME755	Advanced Mechanical Behavior of Materials	ME750	3	3			3
ME756	Mechanical Properties of Engineering Polymers	ME750	3	3			3

4- Design and Applied Mechanics. Track: Elective Courses

CODE	Course Name	Prerequisite	Credit Units	Weekly Contact Hours			
				Lec.	Lab.	Tut.	Sum
ME770	Finite Element Methods in Mechanical Engineering		3	3			3
ME771	Advanced Mechanics of Materials	ME770	3	3			3
ME772	Advanced Dynamics and Vibrations	ME770	3	3			3
ME773	Modern Control Theory	ME770	3	3			3
ME774	Advanced Robotics	ME770	3	3			3
ME775	Materials Selection in Design	ME770	3	3			3
ME776	Dynamics of Rotating Machinery	ME770	3	3			3

Course Code	ME 700			
Course Title	Engineering Mathematics			
Year/Level	1/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	-	-
Prerequisite				
Course Description	This course presents basic mathematical methods for engineers including differentiation and integration, Taylor's expansion, linear systems resolution and matrix formalism, partial differential equations, Laplace, finite, and difference schemes. As well as Fourier and Legendre transforms, statistics and probability. The course also provides statistical methods such as optimality criterion, bracketing methods curve fitting, least squares analysis of regression, various types of regression analyses, conformal mapping, potential theory.			
Textbook	1- PIVATO, Marcus. *Linear partial differential equations and Fourier theory*. Cambridge University Press, 2010. 2- STRIKWERDA, John C. *Finite difference schemes and partial differential equations*. Society for Industrial and Applied Mathematics, 2004. 3- CHAN, Man Fong CF; KALONI, P. N.; DE KEE, Daniel. *Advanced mathematics for engineering and science*. World Scientific Publishing Company, 2003.			

Course Code	ME 701			
Course Title	Experimental Methods and Analysis			
Year/Level	1/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite				
Course Description	The course is divided into three parts. Part I: Design of Experiments: Introduction to industrial experimentation, fundaments of design of xperiments, understanding key interactions, mean effect plots, interaction plots, full actorial design, partial factorial design, error and variance. Part II: Statistical techniques: Basic statistical measurements and their application in Engineering, Statistical analysis of data. P-value plots, α-plots. Probability distributions, sampling distributions, estimation and confidence intervals for parameters of statistical distributions, hypothesis testing, design and analysis of variance for estimation and confidence intervals for parameters of non-statistical models. Single and multiple-factor experiments, regression analysis. Part III: Use of commercial software for analysis of experiments (LabView & MiniTab) in design of experiments and statistical techniques.			
Textbook	1- ANTONY, Jiju. Design of experiments for engineers and scientists. Elsevier, 2014.			

Course Code	ME 702			
Course Title	Modeling and Simulation of Engineering Systems			
Year/Level	1/2			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	-	-
Prerequisite				
Course Description	The course introduces the importance of modeling and simulation, continuous and discrete models, model components, descriptive variables and interaction rules , concept of model state, experimental frames and simplified models, classification of dynamic systems, random numbers generators, Monte Carlo simulation, object- and agent-oriented simulation, signal flow graphs, bond graphs, system dynamics, and system thinking.			
Textbook	1- CHATURVEDI, Devendra K. *Modeling and simulation of systems using MATLAB® and Simulink®*. CRC press, 2017. 2- MUKHERJEE, Amalendu; KARMAKAR, Ranjit; KARMAKAR, R. *Modelling and simulation of engineering systems through bondgraphs*. Alpha Science Int'l Ltd., 2000.			

Course Code	ME711			
Course Title	Introduction to renewable energy Engineering			
Year/Level	1/2			
Hours	Credit	Lec.	Lab.	Tut.
	3	2	1	--
Prerequisite				
Course Description	Introduction meteorology, the sun as a radiation source, solar geometry, interaction of solar energy with atmosphere, measurement and prediction of solar irradiance, spectrum, global distribution, seasonal variation, tilt angle effects, modeling, origin of the atmospheric motion, fundamental forces, balances of the horizontal wind field, wind climatology, wind flow in the atmospheric boundary layer, resource assessment, temperature, pressure and humidity, measuring devices, dust problems.			
Textbook	1- NELSON, Vaughn C. *Introduction to renewable energy*. CRC press, 2011. 2- TWIDELL, John. *Renewable energy resources*. Routledge, 2021.			

Course Code	ME712			
Course Title	Energy Conversion			
Year/Level	1/2			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME711			
Course Description	The course will cover energy classification, solid, liquid and gaseous fuels, sources, utilization, energy conversion to thermal, electrical, and mechanical energies, applications, economics, impacts, fuel cells fundamentals, technologies and applications of fuel cells.			
Textbook	1- SRINIVASAN, Supramaniam. *Fuel cells: from fundamentals to applications*. Springer Science & Business media, 2006. 2- GOSWAMI, D. Yogi; KREITH, Frank. *Energy conversion*. CRC press, 2007.			

Course Code	ME713			
Course Title	Wind Energy			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME711			
Course Description	The course will cover history of wind power, wind characteristics and resources, aerodynamics of wind turbines, dynamics of wind turbines, electrical aspects of wind turbines, wind turbine materials and components, wind turbine design and testing, wind turbine control, wind turbine siting, system design, and integration, wind energy system economics, environmental aspects and impacts.			
Textbook	1. YAN, Jinyue (ed.). *Handbook of clean energy systems*, 6 volume set. John Wiley & Sons, 2015. 2. G L Johnson. *Wind Energy Systems*, Manhattan, KS: G L Johnson, 2006. 3. E. Lysen, E. H. *Introduction to wind energy. Basic and advanced introduction to wind energy with emphasis on water pumping windmills*, 1983.			

Course Code	ME714			
Course Title	Photovoltaic Energy Systems			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME711			
Course Description	The course will cover photo-voltaic and hybrid electrical systems, fundamentals of PV and hybrid systems, charge controllers, inverters, system sizing, mechanical and electrical integration, hybrid systems configurations and components performance, applications, cabling, protection, utility interconnection, permitting, commissioning, maintenance, troubleshooting and economic analysis of PV and hybrid systems.			
Textbook	1. Gilbert M. Masters: Electric Power Systems that are Renewable and Efficient. 2004 John Wiley & Sons 2. Roger A. Messenger and Jerry Ventre. *Photovoltaic systems engineering*. CRC Press, 2nd ed., 2004. 3. *Solar Photovoltaics: Fundamentals, Technologies, and Applications (Solar Photovoltaics*, PHI Learning Pvt Ltd, 2009			

Course Code	ME715			
Course Title	Concentrated Solar Energy Plants			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME711			
Course Description	The course will cover concentrated solar plants (CSP) collectors, line and point focusing collectors, concentrators, tracking mechanisms, general energy balance and explanation of different terms, evaluation of thermal losses, storage effect, transient effect, analysis of specific types of reflective concentrators, parabolic trough, Fresnel concentrators, temperature distributions, performance indices, central-tower receiver, economic and environmental impacts, assessment of CSP potentials, quantify renewable electricity potentials.			
Textbook	1- LOVEGROVE, Keith; STEIN, Wes. *Introduction to concentrating solar power technology*. In: Concentrating Solar Power Technology. Woodhead Publishing, p. 3-17, 2021 2- Blanco, Manuel, ed. *Advances in concentrating solar thermal research and technology*. Woodhead Publishing, 2016.			

Course Code	ME716			
Course Title	Renewable Energy Economics and Planning			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME711			
Course Description	This course provides an overview of the entire renewable energy sphere, while still functioning as a go-to information source for students when they need answers about a specific technical issue. This course is structured around three parts in order to assist students in focusing on the issues that impact them the most for a given project or question. The course is divided into three parts. Part I covers the basic scientific principles behind all major renewable energy resources and its financial issues, such as solar, wind and biomass. Part II provides in depth information about how these raw renewable sources can actually be converted into useful forms, transmitted into the grid and stored for future utilization. Finally, Part III undertakes the aspects of energy planning, environmental impacts and socio-economic issues on regional and global levels.			
Textbook	1- SORENSEN, Bent. *Renewable energy: physics, engineering, environmental impacts, economics and planning*. Academic Press, 2017. 2- ZOBAA, Ahmed F.; BANSAL, Ramesh C. (ed.). *Handbook of renewable energy technology*. World Scientific, 2011.			

Course Code	ME717			
Course Title	Geothermal Energy			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME711			
Course Description	This course provides high and low temperature geothermal areas, utilization of geothermal around the world, geological-, geophysical- and geochemical methods in assessing well testing, drilling technology, design of well heads and well equipment, two-phase flow in vertical and horizontal pipes, steam separators and safety equipment, pipe lines control, corrosion and sealing problems in geothermal systems, design of geothermal utilization systems, direct and indirect heat exchangers multi-purpose use of geothermal energy, ground heat pump, environmental aspect and impacts of geothermal utilization.			
Textbook	1- EDWARDS, L. M., et al. *Handbook of geothermal energy*. 1982. 2- DICKSON, Mary H.; FANELLI, Mario. *Geothermal energy: utilization and technology*. Routledge, 2013. 3- HUENGES, Ernst; LEDRU, Patrick (ed.). *Geothermal energy systems: exploration, development, and utilization*. John Wiley & Sons, 2011.			

Course Code	ME731			
Course Title	Advanced Thermodynamics			
Year/Level	1/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite				
Course Description	This course will cover the fundamentals of classical thermodynamics. First and second law, equilibrium, Euler and Gibbs-Duhem relations. Entropy production, thermodynamic cycles. Legendre transformations and extremum principle. Maxwell relations and thermodynamic derivatives. Stability. Phase transitions. Nernst postulate. Chemical equilibrium. Multi-Component Systems - HVAC Systems - Combustion Systems - Optimization of Systems - Thermodynamic Design Applications.			
Textbook	1- BEJAN, Adrian. *Advanced engineering thermodynamics*. John Wiley & Sons, 2016. 2- DEHOFF, Robert. *Thermodynamics in materials science*. CRC Press, 2006. 3- Holman J.P., *Thermodynamics*, Fourth Edition, McGraw – Hill, 1988. 4- WARK, Kenneth. *Advanced thermodynamics for engineers*. McGraw-Hill, 1995.			

Course Code	ME732			
Course Title	Advanced Fluid Mechanics			
Year/Level	1/2			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME731			
Course Description	This course will cover the conservation equations for viscous fluids. Ideal fluid flow. Boundary layer concept. Navier-Stokes equations and some exact solutions. Stokesian flow. Laminar boundary layer equations and methods of solution. von Karman momentum integral equation. Theory of stability of laminar flows. Introduction to turbulent flow. Stability of laminar flow and causes of transition to turbulence. Conservation equations and Reynolds stresses. Turbulent boundary layer equations, integral and other methods of solution. Free turbulence, wakes and jets. Statistical analysis; scales of turbulence, correlation functions, spectra. Measuring techniques.			
Textbook	1- GRAEBEL, William. Advanced fluid mechanics. Academic Press, 2007. 2- SCHOBEIRI, Meinhard T. Advanced Fluid Mechanics and Heat Transfer for Engineers and Scientists. 2022. 3- MURALIDHAR, Krishnamurthy; BISWAS, Gautam. Advanced engineering fluid mechanics. Alpha Science Int'l Ltd., 2005. 4- SONG, Hongqing. Engineering fluid mechanics. Springer, 2018.			

Course Code	ME733			
Course Title	Convection Heat Transfer			
Year/Level	1/2			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME731			
Course Description	This course will cover the convection systems. Derivation of conservation equations and solutions for laminar and turbulent boundary layer flows. Forced convection, internal and external flows. Natural convection. Special topics and applications.			
Textbook	1- KAKAÇ, Sadık; SHAH, Ramesh K.; AUNG, Win. Handbook of single-phase convective heat transfer. 1987. 2- CEBECI, Tuncer. *Convective heat transfer*. Berlin: Horizons Pub., 2002. 3- KAKAC, Sadik; YENER, Yaman; PRAMUANJAROENKIJ, Anchasa. *Convective heat transfer*. Boca Raton: CRC press, 1995. 4- BEJAN, Adrian. *Convection heat transfer*. John wiley & sons, 2013.			

Course Code	ME734			
Course Title	Advanced Computational Fluid Dynamics Methods			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME731			
Course Description	This course will provide overview of various computational fluid dynamics methods to date, relevance to continuum and non-continuum fluid dynamics. Introduction to Lattice Boltzmann Method (LBM), basics of Kinetic theory of particles, Boltzmann equation. Development of LBM for diffusion equation, diffusion-convection equations, non-isothermal flows, different relaxation techniques. Introduction to Molecular Dynamics Computational Method. Applications and Code Development.			
Textbook	1- POZRIKIDIS, Constantine; JANKOWSKI, D. *Introduction to theoretical and computational fluid dynamics*. New York: Oxford university press, 1997. 2- ZIKANOV, Oleg. *Essential computational fluid dynamics*. John Wiley & Sons, 2019. 3- LOMAX, Harvard, et al. *Fundamentals of computational fluid dynamics*. Berlin: Springer, 2001. 4- TU, Jiyuan; YEOH, Guan Heng; LIU, Chaoqun. *Computational fluid dynamics: a practical approach*. Butterworth-Heinemann, 2018.			

Course Code	ME735			
Course Title	Combustion Emissions and Control			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME731			
Course Description	This course will cover the combustion emissions, mechanisms of emissions formation, effects of design and operating parameters on emission formation in various energy conversion devices including diesel engine, SI engine, and GT engine, emissions from solid fuels, heavy oils, gaseous fuels, and biofuels, effect of fuel quality on emissions, emission control and instrumentation.			
Textbook	1- BARI, Saiful (ed.). *Diesel Engine: Combustion, Emissions and Condition Monitoring*. BoD–Books on Demand, 2013. 2- PATTERSON, Donald J.; HENEIN, Naeim Abdou. Emissions from combustion engines and their control. 1981. 3- BAUKAL, Charles E. *Industrial combustion pollution and control*. CRC Press, 2003.			

Course Code	ME736			
Course Title	Thermal Design of Heat Exchangers			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME731			
Course Description	This course will cover the classification of a variety of heat exchangers, various methods for the exchanger analysis and performance evaluation, pressure drop analysis including head design and flow misdistribution, fouling and its impact on the exchanger performance and life-cycle analysis. Special design considerations for regenerators, plate-fin, tube-and-frame, shell-and-tube, boilers, condensers, evaporators, and direct-contact heat exchangers.			
Textbook	1- ROETZEL, Wilfried; LUO, Xing; CHEN, Dezhen. *Design and operation of heat exchangers and their networks*. Academic Press, 2019. 2- MITROVIC, Jovan (ed.). *Heat Exchangers: Basics Design Applications*. BoD–Books on Demand, 2012. 3- LEE, Ho Sung. *Thermal design: heat sinks, thermoelectrics, heat pipes, compact heat exchangers, and solar cells*. John Wiley & Sons, 2010. 4- KAKAC, Sadik; LIU, Hongtan; PRAMUANJAROENKIJ, Anchasa. *Heat exchangers: selection, rating, and thermal design*. CRC press, 2002.			

Course Code	ME737			
Course Title	Desalination and Water Purification			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME731			
Course Description	This course will cover the water purification by desalination and filtration. Fundamentals of thermodynamics and transport processes. Least work of separation and maximum GOR. Technologies of existing desalination systems. Energy efficiency of desalination systems. Nano filtration and emerging technologies for desalination. Rain water and fog collection and treatment. Selection and design of a cistern water systems. Life cycle water costs.			
Textbook	1- LORCH, Walter. Handbook of water purification. 1987. 2- NATIONAL RESEARCH COUNCIL, et al. *Review of the desalination and water purification technology roadmap*. National Academies Press, 2004. 3- DEY, Tania. *Nanotechnology for water purification*. Universal-Publishers, 2012. 4- SINGH, Rajindar. *Membrane technology and engineering for water purification: application, systems design and operation*. Butterworth-Heinemann, 2014.			

Course Code	ME750			
Course Title	Additive Manufacturing Engineering			
Year/Level	1/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite				
Course Description	This course will cover the additive manufacturing (AM) or 3D printing processes for metallic alloys, polymers, ceramics, and composites: vat photopolymerization, powder bed fusion, extrusion-based systems, binder and materials jetting, sheet amination, directed energy deposition, and direct write. Basic interrelations among AM processing parameters, parts microstructures, and mechanical properties. Process selection, design for AM, and the impact of AM in revolutionizing manufacturing industries. Reverse engineering technology including digitizing processes through optical scanning and laser scanning.			
Textbook	1- WIMPENNY, David Ian, et al. (ed.). *Advances in 3D printing & additive manufacturing technologies*. Singapore: Springer, 2017. 2- CHUA, Chee Kai; LEONG, Kah Fai. *3D Printing and additive manufacturing: Principles and applications (with companion media pack)-of rapid prototyping*. World Scientific Publishing Company, 2014. 3- BANDYOPADHYAY, Amit; BOSE, Susmita (ed.). *Additive manufacturing*. CRC press, 2019. 4- SINGH, Rupinder; DAVIM, J. Paulo (ed.). *Additive Manufacturing: Applications and Innovations*. CRC Press, 2018.			

Course Code	ME751			
Course Title	Computer Integrated Manufacturing			
Year/Level	1/2			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME750			
Course Description	This course concerns with study of the impact of computers and automation on discrete parts manufacturing. Flexible manufacturing and assembly equipment. CAD/CAM concepts and applications. Process planning and manufacturing scheduling. Materials handling. Robotics. Quality assurance. Tooling and fixtures for CNC systems.			
Textbook	1- ALAVUDEEN, A.; VENKATESHWARAN, N. *Computer integrated manufacturing*. PHI Learning Pvt. Ltd., 2008. 2- SARCAR, M. M. M.; RAO, K. Mallikarjuna; NARAYAN, K. Lalit. *Computer aided design and manufacturing*. PHI Learning Pvt. Ltd., 2008. 3- BI, Zhuming; WANG, Xiaoqin. *Computer aided design and manufacturing*. John Wiley & Sons, 2020.			

Course Code	ME752			
Course Title	Deformation, Fatigue and Fracture of Engineering Materials			
Year/Level	1/2			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME750			
Course Description	This course will cover a review of basic mechanical testing, elastic deformation, stress transformation and static failure theories. Fracture mechanics. Stress-based fatigue for smooth and notched members. Fatigue crack growth. Modeling and analysis of plastic deformation. Strain-based fatigue.			
Textbook	1- BOLOTIN, Vladimir V. *Mechanics of fatigue*. CRC Press, 2020. 2- ANDERSON, Ted L. *Fracture mechanics: fundamentals and applications*. CRC press, 2017. 3- BROEK, David. *Elementary engineering fracture mechanics*. Springer Science & Business Media, 1982. 4- LEE, Yung-Li, et al. *Fatigue testing and analysis: theory and practice*. Butterworth-Heinemann, 2005.			

Course Code	ME753			
Course Title	Advanced Machining Processes			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME750			
Course Description	This course will cover the non-conventional and hybrid processes based on high thermal energy sources including laser beam, electric discharge, electron beam, and plasma arc; mechanical processes including abrasive jet, water jet, ultrasonic, and hybrids; chemical and electrochemical processes. Design, quality, integrity of machined products, and economics of advanced machining.			
Textbook	1- JAIN, Vijay Kumar. *Advanced machining processes*. Allied publishers, 2009. 2- KUMAR, Kaushik; KUMARI, Nisha; DAVIM, J. Paulo (ed.). *Non-Conventional Machining in Modern Manufacturing Systems*. IGI Global, 2018. 3- BHATTACHARYYA, Bijoy; DOLOI, Biswanath. *Modern machining technology: Advanced, hybrid, micro machining and super finishing technology*. Academic Press, 2019.			

Course Code	ME754			
Course Title	Advanced Corrosion Engineering			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME750			
Course Description	This course will cover the corrosion thermodynamics and kinetics. Pourbaix diagrams, mass transfer and corrosion. Effect of environmental factors on major forms of corrosion. Anodic and cathodic protection of metals. Organic and nonmetallic coating. Testing, monitoring and inspection. Materials selection for corrosion resistance.			
Textbook	1- AHMAD, Zaki. *Principles of corrosion engineering and corrosion control*. Elsevier, 2006. 2- FONTANA, Mars Guy, et al. *Corrosion engineering*. McGraw-hill, 2018. 3- ROBERGE, Pierre R. *Corrosion engineering*. McGraw-Hill Education, 2008.			

Course Code	ME755			
Course Title	Advanced Mechanical Behavior of Materials			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME750			
Course Description	This course deals with the point defects and its effects on mechanical properties. Theory and characteristics of dislocations. Grain and twinning boundaries in plastic deformation, geometry of deformation and work-hardening, strengthening mechanisms. Microscopic aspects of fracture, modes of fracture. Deformation at elevated temperatures, superplasticity, deformation maps.			
Textbook	1- COURTNEY, Thomas H. *Mechanical behavior of materials*. Waveland Press, 2005. 2- MEYERS, Marc André; CHAWLA, Krishan Kumar. *Mechanical behavior of materials*. Cambridge university press, 2008. 3- HOSFORD, William F. *Mechanical behavior of materials*. Cambridge university press, 2010.			

Course Code	ME756			
Course Title	Mechanical Properties of Engineering Polymers			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME750			
Course Description	The course will cover the general introduction to polymers and their applications. Types of mechanical behavior. Hookean and rubber elasticity. Plastic deformation. Fracture. Linear viscoelasticity. Dynamic mechanical behavior and testing. Experimental methods. Mechanical properties of polymeric composites.			
Textbook	1- LANDEL, Robert F.; NIELSEN, Lawrence E. *Mechanical properties of polymers and composites*. CRC press, 1993. 2- SWEENEY, John; WARD, Ian M. *Mechanical properties of solid polymers*. John Wiley & Sons, 2012. 3- BRINSON, Hal F., et al. Polymer engineering science and viscoelasticity. *An introduction*, 2008, 99-157.			

Course Code	ME 770			
Course Title	Finite Element Methods in Mechanical Engineering			
Year/Level	1/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite				
Course Description	The course will introduce the finite element analysis and formulation, advanced meshing, identification of FE based theory and tools for problem solving; Linear and Non-linear FEA; Modeling of Materials (Metal and Non-Metals) for Structural, Thermal including phase change, Fluids, and Electromagnetic analysis; Practical applications in component design and materials processing; Future developments.			
Textbook	1- LIU, Wing Kam, et al. *Nonlinear finite elements for continua and structures*. John Wiley & Sons, 2013. 2- CHANDRUPATLA, Tirupathi; BELEGUNDU, Ashok. *Introduction to finite elements in engineering*. Cambridge University Press, 2021.			

Course Code	ME771			
Course Title	Advanced Mechanics of Materials			
Year/Level	1/2			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME770			
Course Description	The course will present the strain energy methods; Thin and thick cylinders; Shrink fit assemblies; Rotating discs; Thermal stresses, elastic, thermo-elastic, and elastoplastic analysis of cylinders; Plates and Shells; Axisymmetric bending problems; Beams on elastic foundations; Torsion of non-circular sections; Photo-elasticity.			
Textbook	1- BORESI, Arthur Peter, et al. *Advanced mechanics of materials*. Wiley, 1985. 2- SOLECKI, Roman; CONANT, R. Jay. *Advanced mechanics of materials*. Oxford University Press, 2003. 3- COOK, Robert Davis; YOUNG, Warren Clarence. *Advanced mechanics of materials*. Prentice Hall, 1999.			

Course Code	ME772			
Course Title	Advanced Dynamics and Vibrations			
Year/Level	1/2			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME770			
Course Description	The course introduces the fundamentals of Newtonian dynamics. Hamilton's Principle and Lagrange's equations. Relativistic dynamics. Central force motion and stability of circular orbits. Rigid body dynamics. Euler's equations of motion, Euler angles, gyroscopic motion, spinning projectile, Hamilton's equations and phase space. Hamilton-Jacobi equation. Review of single-degree of freedom oscillator: formulation using generalized stiffness, inertia and damping. Damping mechanisms: viscous, friction and complex. Response to transient and general excitations. Multiple-degree of freedom systems: formulation and methods of solution. Direct stiffness, influence coefficients and variational approaches. Eigenvalue analysis. Vibration of continuous systems. Approximation methods of continuous systems. Modal reduction technique.			
Textbook	1- KACHAPI, Seyed Habibollah Hashemi; GANJI, Davood Domairry. *Dynamics and Vibrations: Progress in Nonlinear Analysis*. Springer Science & Business Media, 2013. 2- GÉRADIN, Michel; RIXEN, Daniel J. *Mechanical vibrations: theory and application to structural dynamics*. John Wiley & Sons, 2014. 3- THORBY, Douglas. *Structural dynamics and vibration in practice: an engineering handbook*. Butterworth-Heinemann, 2008.			

Course Code	ME773			
Course Title	Modern Control Theory			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME770			
Course Description	The course will cover the introduction to control systems; State space representation; Solving state space equations; Controllability; Observability; Observer design; Control system design in state space; Linear Optimal Control: LQR; Optimal filtering: Kalman filter, Least square filter; Digital control systems; Advanced topics in modern control; Introduction to intelligent control.			
Textbook	1- BAKSHI, Uday A.; BAKSHI, Mayuresh V. *Modern control theory*. Technical Publications, 2020. 2- NAKHMANI, Arie. *Modern Control: State-Space Analysis and Design Methods*. McGraw-Hill Education, 2020. 3- BUBNICKI, Zdzislaw. *Modern control theory*. Berlin: Springer, 2005.			

Course Code	ME774			
Course Title	Advanced Robotics			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME770			
Course Description	This course introduces students to the broad field of robotics predominately from an artificial intelligence perspective. It covers the topics of advanced programming and hardware concepts related to working robots, networking of robots, 3-D kinematics, and trajectory generation and compliance analysis. Dynamics and control of robots. Assembly pertains and machine vision. Industry automation, safety procedures and standards. The course also covers the advanced topics of robot learning and bio-inspired robots. In addition to the theory, the course also has a significant practical, hands-on dimension that comprises introduction to relevant software tools (simulators and operating systems) and hands-on experiments with simulated and physical robots.			
Textbook	1- NIKU, Saeed B. *Introduction to robotics: analysis, control, applications*. John Wiley & Sons, 2020. 2- Brady, M., Gerhardt, L. A., & Davidson, H. F. (Eds.). *Robotics and artificial intelligence (Vol. 11)*. Springer Science & Business Media, 2012). 3- Craig, J. J. *Introduction to Robotics*. Pearson Higher Ed. 2021. 4- MUELLER, Andreas. Modern robotics: *Mechanics, planning, and control*. IEEE Control Systems Magazine, 39.6: 100-102, 2019. 5- CHOSET, Howie, et al. *Principles of robot motion: theory, algorithms, and implementations*. MIT press, 2005.			

Course Code	ME775			
Course Title	Materials Selection in Design			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME770			
Course Description	Engineering design process and the role of materials. Materials classification and their properties; material property charts; selection of materials based on function, objective, constraints, and free variables; examples of material selection for typical applications; Computer-aided materials selection. Selection of process based on material classification; pencil curve approach; material selection for multiple constraints and multiple objective cases; multiple constraints and conflicting objectives. Co-selection of material and shape; the concept of macroscopic and microscopic shape factors; Four quadrant method of material selection. General Properties of plastics, polymers, and elastomers; visco-elastic properties; short-term and long-term properties of plastics; mathematical modeling of plastic properties; Maxwell, Kelvin-Voigt Models; fatigue and fracture of plastics; selection of plastics based on mechanical properties, degradation due to environment, wear; Design methods for snap fits; case studies. Fundamentals of fiber-reinforced plastics; Stress, strain analysis of continuous fiber composites, rule of mixtures, general deformation behavior of laminates. Introduction to high-temperature materials; families of super alloys and their characteristics; creep and fatigue resistance of super alloys; the role of precipitates in the strengthening of superalloys; repair of superalloys after creep damage; coatings for high-temperature materials. Fundamentals of ceramics, general properties, applications of ceramics for critical applications. Design considerations. Surface treatment of materials using coatings; type of coatings; PVD and CVD coatings. Basics of electro-plating and electro-less plating			
Textbook	1- ASHBY, Michael F.; CEBON, David. Materials selection in mechanical design. *Le Journal de Physique IV*, 3.C7: C7-1-C7-9, 1993. 2- BRALLA, James G. *Design for manufacturability handbook*. McGraw-Hill Education, 1999.			

Course Code	ME776			
Course Title	Dynamics of Rotating Machinery			
Year/Level	2/1			
Hours	Credit	Lec.	Lab.	Tut.
	3	3	--	--
Prerequisite	ME770			
Course Description	This course will deal with the problems of dynamics and vibration associated with most kinds of rotating machinery. Examples include turbomachines (steam turbines, gas turbines, pumps, compressors), electric machines (motors, generators), and machines with rotating components such as centrifuges. The aspects of modeling such rotor-disk-bearing assemblies will be explored in detail. Since fluid-film bearings are in wide use, the effect of these bearings on the dynamics of rotors will be studied. Apart from detailed analysis of some simplified models, general methods of modeling and analysis such as finite element and transfer matrix approaches will be discussed. Other aspects to be included in the course are, the effect of internal damping on the stability of the system, the phenomenon of oil whirl, the theory and practice of balancing of rotating components, and the influence of nonlinearities on the vibrational response of the system.			
Textbook	1- Adams, M. L. (2000). *Rotating machinery vibration: from analysis to troubleshooting*. CRC Press. 2- Vance, J. M. (1991). Rotordynamics of turbomachinery. John Wiley & Sons. 3- GENTA, Giancarlo. *Dynamics of rotating systems*. Springer Science & Business Media, 2005. 4- RAO, J. S. *Rotor dynamics*. New Age International, 1996. 5- DIMAROGONAS, Andrew D.; PAIPETIS, Stefanos A.; CHONDROS, Thomas G. *Analytical methods in rotor dynamics*. Springer Science & Business Media, 2013.			

Course Code	ME 798			
Course Title	Project			
Year/Level	2/1-2			
Hours	Credit	Lec.	Lab.	Tut.
	6		12	
Prerequisite				
Course Description	Design-related capstone projects in the domains of mechanical engineering will be carried out. The design approach used in the present project is based on engineering design methodology which is a process of devising a system, component, or process to meet desired needs and specifications within constraints. It is an iterative, creative, decision-making process in which the basic sciences, mathematics, and engineering sciences are applied to convert resources into solutions. The project evaluation will be carried out by an internal examiner within the institute or will be evaluated by both an internal examiner within the institute and an external examiner from another university in Saudi Arabia.			
Textbook	Prescribed by the supervisor of the project			