COURSE STRUCTURE FOR M.TECH (Nuclear Engineering)
SEMESTER I w.e.f. 2013-2014

Sr. No	Course Code	Course Name	Teaching Scheme					Exam Scheme					
			L	T	P	C	Hrs/wk	Theory			Practical		Total Marks
								MS	ES	IA	LW	LE/Viva	
1.	MA501T	Advanced Numerical Methods and Computer Programming	3	0	0	6	3	30	60	10	--	--	100
2.	NE501	Introduction to Nuclear Technology	2	0	0	4	2	30	60	10	--	--	100
3.	NE502	Nuclear Reactor Theory	3	1	0	7	4	30	60	10	--	--	100
4.	NE503	Nuclear Thermal Hydraulics	3	1	0	7	4	30	60	10			100
5.	NE504	Radio-Isotope Applications	3	0	0	6	3	30	60	10	--	--	100
6.	SE505	Renewable Energy and Energy Management	3	0	0	6	3	30	60	10	--	--	100
7.	NE500	Seminar	2	0	0	4	2						
8.	MA501P	Advanced Numerical Methods (Lab)	0	0	2	1	2						
		Total	19	2	2	41	23						

MS = Mid Semester, ES = End Semester; IA = Internal assessment (like quiz, assignments etc)

LW = Laboratory work; LE = Laboratory Exam

Elective : No Electives

MA501T : Advanced Numerical Methods and Computer Programming										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory		Tutorial	Term Work	Practical /Viva	Total Marks
					MS (2.0Hrs)	ES (3.0Hrs)				
3	0	0	6	3	40	60	--	--	--	100

Computer Representation of Numbers, Interpolation, Numerical Differentiation, Numerical Integration, Curve Fitting, Finding Zeros of a Function, Finding Roots of a Polynomial, Numerical Solutions of Ordinary Differential Equation, Numerical Solutions of Partial Differential Equation, Solution of Linear Algebraic Equations, Eigen Value Problems

Textbooks and References:

1. **H.Anton ,"Elementary linear algebra with applications", John Wiley .**
2. **G.Strang, Thomson, "Linear algebra and its applications".**
3. **S.Kumaresan, "Linear algebra – A Geometric approach", Prentice Hall of India .**
4. **E.Kreyszig, "Advanced engineering mathematics", John Wiley .**
5. **W.E.Boyce and R. DiPrima, "Elementary Differential Equations", John Wiley.**
6. **T.M.Apostol, "Calculus", Volume 2 (2nd Ed.), Wiley Eastern.**

NE501 Introduction to Nuclear Technology										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory		Tutorial	Term Work	Practical /Viva	Total Marks
					MS (2.0Hrs)	ES (3.0Hrs)				
2	0	0	0	2	40	60	--	--	--	100

Overview of Nuclear Technology, Role of Nuclear Energy in Global Scenario, Future of Nuclear Power, Constraints in Nuclear Power Plant, Introduction to Nuclear Fuel Cycle, Nuclear Power, Plant Safety, Nuclear Power Management, Process – Storage – Disposal of Nuclear Waste Environmental Considerations in Nuclear Power Plant

Textbooks/ References:

1. **S. Glasston & A. Sesonske, Nuclear Reactor Engineering Vol 1 and 2, Publisher Cbs. 4th edition, 2004.**
2. **J. R. Lamarsh and A. J. Baratta, Introduction to Nuclear Engineering 3rd Edition, Prentice Hall, 2001.**
3. **Nuclear Engineering Hand book Edited by Kenneth D. Kok**

NE502 Nuclear Reactor Theory										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory		Tutorial	Term Work	Practical /Viva	Total Marks
					MS (2.0Hrs)	ES (3.0Hrs)				
3	1	0	7	4	40	60	25	--	--	125

Review of Nuclear Physics:

Mass defect, Nuclear Force, Binding energy per nucleon curve, Fission and fusion reactions, Radioactivity, Nuclear reactions, Neutron-nucleus interactions, Compound nucleus formation, Microscopic and macroscopic reaction cross sections, Conservation of charge, mass number and momentum, Centre of mass and laboratory frames of reference, Single level Breit Wigner Formula Fission and Fusion Reactions

Reactor Physics:

Neutron number density, scalar and angular flux ,cross sections, Fick's law, neutron diffusion, fluxes due to point and plane sources, Steady state and time dependent neutron diffusion equation, Neutron multiplication factor, the four-factor and six-factor formulae, Neutron balance, conditions of criticality, Conversion and breeding, One-group and two group criticality conditions for bare and reflected reactors, Neutron slowing down in hydrogen and other materials, neutron lethargy, Slowing down equation, age equation and age-diffusion equation, fundamental and higher modes, their rise and decay, Point kinetics, reactivity feedback, temperature coefficients of reactivity, Neutron energy spectra Maxwell-Boltzmann distribution, group constants, Energy dependent neutron and diffusion, multi-group approximation, Criticality calculations, subcritical multiplication, Reactor kinetics, reactivity equation, units of reactivity, Reactivity feedback, temperature coefficients, Long term and short term reactivity changes, reactivity control, fission product poisoning, Xenon and Samarium build up and decay, Plutonium buildup and fuel depletion calculations, Neutron cross section processing

Text Books/ References:

1. **J. R. Lamarsh and A. J. Baratta, "Introduction to Nuclear Engineering", Prentice Hall**
2. **J. R. Lamarsh, "Introduction to Nuclear Reactor Theory", Addison Wesley**
3. **J. J. Duderstadt and L. J. Hamilton, "Nuclear Reactor Analysis", John Wiley**
4. **E. E. Lewis, "Fundamentals of Nuclear Reactor Physics", Elsevier**

NE503 Nuclear Thermal Hydraulics										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory		Tutorial	Term Work	Practical /Viva	Total Marks
					MS (2.0Hrs)	ES (3.0Hrs)				
3	1	0	7	4	40	60	25	--	--	125

Overview of Nuclear Reactor Systems, Heat generation in Reactors , Basic modes of heat transfer and Thermal Conductivity, Capacity and Diffusivity 1-D Steady-State Heat Conduction without Heat Generation – Plane Wall , 1-D Steady-State Heat Conduction with Heat Generation, Conduction Through Hollow Cylinder, Sphere, Series-Composite Slab Heat Flow Through Composite Structures, Critical Thickness of Insulation, Variable Thermal Conductivity Conduction Heat Transfer in Multidimensional Systems, Transient Heat Transfer, Convective Heat Transfer and Heat Transfer Coefficient with Phase Change, Condensation and Boiling Dimensional Analysis, Radiation Heat Transfer , Pressure Drop Analysis, Sub channel Analysis of Rod Bundle Fuels, Hotspot and Hot channel Factors

Textbooks/ References:

1. **N. E. Todreas and M. M. Kazimi, "Nuclear Systems, Vol-1: Thermal Hydraulic Fundamentals", Hemmisphere Pub. Co**
2. **J. P. Holman, "Heat Transfer", The McGraw Hill Companies**
3. **P. K. Nag, "Heat and Mass Transfer", Second Edition, The McGraw Hill Companies**

NE504 Radioisotope Applications										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory		Tutorial	Term Work	Practical /Viva	Total Marks
					MS (2.0Hrs)	ES (3.0Hrs)				
3	0	0	6	3	40	60	--	--	--	100

Radioactivity, Counting Statistics, Radio Carbon Dating, Radiometric dating, Mass Spectrometry, Introduction to Nuclear Detectors Age of the earth, Radiation Safety, Radiotracer Principles
Flow Measurements, Applications in Analysis, Isotope dilution, Wear measurements and other production, engineering applications, Selected examples of industrial radiotracer applications, Radio gauging principles, Alpha particle gauges based on transmissions, X-ray Fluorescence principles, Neutron gauges, Radiation therapy, Sterilization plants, Radiation processing and food irradiation

Textbooks and References:

1. **Robin P. Gardner, Ralph L. Ely, "Radioisotope measurement applications in engineering", Reinhold**
2. **Gunther Faure, Teresa M. Mensing, "Isotopes Principles and Applications", John Wiley and Sons**