ELECTIVE COURSES

List of Electives

Sl.No	Course Code	Course Tile
1.	DES507	Design History
2.	MEC507	Computational Fluid Dynamics
3.	INT503	Green Energy and Product Design
4.	ELE506	Communication Systems
5.	ELE507	Electromagnetic Interference and Compatibility
6.	INT502	Probabilistic Engineering Design
7.		Design of Electronic Cooling System and Packaging
8.	MEC505	Automobile Engineering and Systems
9.		Micro Electro Mechanical Systems
10.		Transforms and Their Applications
11.		Optical Fiber Communication
12.		Smart Materials & Applications
13.		Principles of Economics
14.		Logistics & Distribution Management
15.		Advanced Data Structures & Algorithms
16.		Computer Aided Process Planning

Syllabus

DES507 Design History

Definition of Design; Origin of designers; Historical context of design and designers.
Designers and designed products: Art, design and technology - Select International and Indian designers.
Industrial Revolution: Mass production, Birth of Modern architecture, International Style, The modern home.
Craft and Design: Type forms; William Morris and Arts and Craft Movement; Shantiniketan.
Design movements: Art Nuoveau; Art Deco, Werkbund; Bauhaus; De Stijl.
Changing values:
Information Revolution: Impact of technology, industrialization and globalization on design: kitsch, pastiche, 'retro'; Shopping malls.
Design Studies: Materials and techniques; Chinese ceramics; Typology; Content analysis: Anthropology / sociology; Nationalist and global trends in Design; Nationalist Design; Global trends and global identity; Nostalgia, Heritage and Design

References:

1. Conway Hazel, Design History – A Students' Handbook, Routledge: London, 1987.
2. Raizman David, History of Modern Design, Graphics and Products since the Industrial Revolution. Laurence King Publishing :London, 2003
3. Walker John. A, Design History and History of Design. Pluto Press: London, 2003.
4. Woodham Jonathan M, Twentieth Century Design, Oxford University Press: Oxford, 2003.

MEC507 Computational Fluid Dynamics

Basics of computational fluid dynamics – governing equations of fluid mechanics and heat transfer – physical boundary conditions – elliptic, parabolic and hyperbolic equations. Finite difference formulation – stability analysis.

Solution methodologies: direct and iterative methods, Thomas algorithm, relaxation method, alternating direction implicit method.

Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation.

Finite volume formulation of steady one-dimensional convection and diffusion problems, central, upwind, hybrid and power-law schemes - discretization equations for two dimensional convection and diffusion.

Numerical methods for the Navier-Stokes equation - Turbulence models: mixing length model, two equation (k-epsilon) models – Grid generation.

Text Books:

1. Pradip Niyogi, Chakrabartty S.K., Laha M.K., Introduction to Computational Fluid Dynamics, Pearson Education, 2Ed. 2009.
2. Versteeg Henk Kaarle, Malalasekera Weeratunge, An Introduction to Computational Fluid Dynamics: The finite volume method, Pearson Education, 2007.

References:

1. Patankar, S.V., Numerical Heat Transfer and Fluid Flow, McGraw-Hill, 1980.
2. Muralidhar, K, Sundarajan .T. Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi, 1995.
3. Anderson, J.D., Computational Fluid Dynamics – The Basics with Applications, McGraw-Hill, 1995.

INT503 Green Energy and Product Design

Types of green energy, Basics of green energy production, Energy harvesting techniques. Heat exchange methods (6)

Solar heaters, Cookers, Dryers, Solar concentrators, Applications, Performance evaluation, BIS Standards, Economics, Life cycle costing (10)

Photovoltaics – Basic principle of SPV conversion, types of solar cells, SPV system designing, load estimation, selection of inverter, battery sizing, array sizing, wiring for SPV system (7)

Solar refrigerator, thermoelectric refrigerator and generator, Applications, and performance evaluation, Fundamentals of fuel cells (8)

Wind turbines, Design procedures and Performance evaluation. (4)

Lighting Systems - luminance requirements, electronic ballast, occupancy sensors, energy efficient lighting control, fiber optic solar lighting system (7)

Text Books:

1. S. Kakaç and H.Liu, Heat exchangers: selection, rating, and thermal design, 2ndEdn., CRC Press, 2002.
2. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, 2ndEdn., John Wiley, 1991.
3. L.C.Witte, P.S.Schmidt, D.R.Brown, Industrial Energy Management and Utilisation, 1st Ed., Taylor & Francis, 1988.

References:

1. J. Twidell and T. Weir, Renewable Energy ResourcesTaylor and Francis, 2005.
2. P.Würfel, Physics of Solar Cells: From Basic Principles to Advanced Concepts, Wiley Publication, 2009.
3. D.M. Rowe, Handbook of Thermoelectrics, CRC Press, 1995.
4. J.F. Manwell, J. G. McGowan, A. L. Rogers, Wind Energy Explained: Theory, Design and Application, 2nd Ed., Wiley, 2010.
5. A.J. Appleby, F.R. Foulkers, Van Nostrand, Fuel Cell Handbook, Van Nostrand Reinhold Company, 1989.

ELE506 Communication Systems

Communications: Random signals and noise: probability, random variables, probability density function, autocorrelation, power spectral density. Noise, AWGN, SNR, Fundamentals of information theory and channel capacity theorem, Link design, Satellite links, point to point link, wired links

Analog communication systems: amplitude and angle modulation and demodulation systems, spectral analysis, super heterodyne receivers; elements of hardware, realizations of analog communication systems; signal-to-noise ratio calculations for analog communication systems. Capacity utilization of AM/FM

Digital communication systems: Why digital communication? Pulse code modulation, differential pulse code modulation, matched filter receivers, multiple users, Interference SINR, bandwidth consideration and probability of error calculations for these schemes. TDMA, FDMA, CDMA and GSM; Capacity utilization of PCM

Text Books:

1. Simon Haykin, Michael Moher, An Introduction to Analog and Digital Communications, John Wiley, 2006, 2nd Edition.

Reference:

1. B. P. Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press, 2009, 4th Edition.
2. Simon Haykin,Communication Systems, John Wiley, 2009, 5th Edition.
3. Leon W. Couch, Digital & Analog Communication Systems, Prentice Hall, 2007, 7th Edition.
4. Rodger E. Ziemer, William H. Tranter, Principles of Communications, John Wiley, 2008, 6th Edition.

ELE507 Electromagnetic Interference and Compatibility

Electronic Equipment and System EMI Concepts- EMC Requirements for Electronic Systems, Equipment Emissions and Susceptibilities

Common-Mode and Differential mode Coupling- Mechanisms Including Field to Cable, Ground Impedance, Ground Loop and Coupling Reduction Techniques, Other Coupling Mechanisms, Arcing at switches and its suppression

Non ideal behavior of components- resistance, capacitance and inductance of wires, equivalent circuits, Resistors, capacitors, inductors, effect of component leads, digital circuit devices, effect of component variability

The Importance of Grounding For Achieving EMC- The Reasons (I.E., Safety, Lightning Control, EMC, etc.), Grounding Schemes (Single Point, Multi-Point And Hybrid), Shield Grounding and Bonding.

Importance of Shielding- Shielding Effectiveness, Shielding Considerations (Reflective and Absorptive) Shielding Design, Shielding Compromises

Techniques Used in EMI Diagnostics and Fixes, EMC Specifications, Standards and Measurements, EMC Documentation Including a Historical Summary, The Rationale, and a Review of MIL-Stds, FCC and CISPR Requirements.

Introduction to Electromagnetic Compatibility, Communications System EMI- Typical Modes of System Interactions Including Antennas, Transmitters and Receivers and Receiver Responses, Elements of Interference, including Antennas, Transmitters, Receivers and Propagation

Text Books:

1. Clayton R. Paul, Introduction to Electromagnetic Compatibility, John Wiley,2006, 2nd Edition.

References:

1. Henry Ott, Electromagnetic Compatibility Engineering, John Wiley, 2009
2. Clayton, Electromagnetics for Engineers: With Applications to Digital Systems and Electromagnetic Interference, John Wiley, 2004.
3. David A. Weston, Electromagnetic Compatibility: Principles and Applications, Marcel Dekker Inc., 2001, 2nd Edition.

INT502 Probabilistic Engineering Design

Probability: Review of basic probability, discrete and continuous distributions Monte Carlo Simulation
Probabilistic Design Concepts: Failure Mode and Effect Analysis, Quality function deployment, Taguchi Method for design of experiments -Design for product life cycle.
Robust and Optimum Design: Performance variation due to variation in design parameters, human properties and environmental conditions, optimum design concepts.
Design for Reliability and Maintainability: Reliability, availability and maintainability; distribution of failure and repair times; determination of MTBF and MTTR, reliability models; system reliability determination; factor of safety and reliability, preventive maintenance and replacement, total productive maintenance. Reliability analysis of Mechanical, electrical and electronic Systems.

References:

1. Douglas. C. Montgomery, Applied Probability and Statistics for Engineers, John Willey, 2006.
2. J. Antony, Design of experiments for Engineers and Scientists, Butterworth-Heinemann, 2004.
3. James. N. Siddall, Probabilistic Engineering Design, CRC Press, 1983.
4. Dhillon, Engineering Maintainability – How to design for reliability and easy maintenance, PHI, 2008.
5. Charles E Ebling, An Introduction to Reliability and Maintainability Engineering, Tata- McGraw Hill, 2000

***### Design of Electronic Cooling System and Packaging

Cooling Load of Electronic Equipment in a Thermal Environment - Thermal consideration in The Chip Carrier, PCBs and Enclosure. (5 hrs)
Design Application of Conduction Cooling, Heat sinks, Conduction in Chip Carriers, Conduction in PCB, Heat Frames and Thermal Conduction Module (TCM) (10 hrs)
Design application of Natural Convection and Radiation in electronic cooling (5 hrs)
Design application of Forced Convection Cooling - Fan Selection, fluid selection, Liquid Cooling, Immersion Cooling (10 hrs)
Design and analysis for mechanically reliable systems and thermal mapping of Electronic devices (10 hrs)
Electronic energy harvesting – Peltier and Seebeck effects (5 hrs)

Text books:

1. Ralph Remsburg, Advanced Thermal Design of Electronic Equipment, 1st Ed, 1998, CRC Press
2. Dave S. Steinberg, Cooling Techniques for Electronic Equipment, 1991, John Wiley & Sons, Inc

References:

1. W.M. Rohsenow, J.P Hartnett,C. Young, Heat Transfer Handbook, 1998, McGraw-Hill
2. Kaveh Azar, Thermal Measurements in Electronics Cooling, 1997, CRC Press
3. All Jamnia , Practical Guide to the Packaging of Electronics, 2002, CRC Press
4. Yunus A. Cengel and Michael Boles Thermodynamics: An Engineering Approach, 6th Ed, 2001, McGraw-Hill

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MEC505 Automobile Engineering and Systems

Power plant: Principles of Engine operation, Engine parts, cooling systems, Lubrication systems, Fuel systems, Emission standard and testing. (16 hrs)
Structures: Construction, function, loading, principles of suspension, suspension systems and mechanics (6 hrs)
Transmission systems: Clutch, Flywheel, Gear Boxes – types and construction (7 hrs)
Vehicle controls: Steering Geometry and Types, Brakes – construction and types (7 hrs)
Auto electrical and electronics: Battery Generator, Starting Motor, Lighting and Ignition, Electronic Fuel Injection (4 hrs)
Alternative concepts: Alternative fuels – types, Basics of electric and hybrid vehicles, fuel cells. (5 hrs)

Text books:

1. Heitner, Automotive Mechanics, East west Press
2. Heisler H, Advanced Engine Technology, Edward Arnold 1995
3. Kirpal singh,Vol I&II ,Automobile Engineering, Standard Publishers Distributers

References:

1. Pulkrabek, Willard W. 2003, Engineering Fundamentals of the Internal Combustion Engine, 2nd Edition, New Jersey, Prentice Hall
2. William Crouse, "Automobile Engineering Series ", McGraw-Hill, 1988.
3. Newton and Steeds, "Motor Vehicles ", ELBS, 1985.
4. Automotive Handbook, 3rd Edition, Bosch GmbH by S.A.E. 1993

***### Micro Electro Mechanical Systems

Introduction to MEMS & Microsystems, Introduction to Microsensors, Evaluation of MEMS, Microsensors, Market Survey, Application of MEMS
MEMS Materials, MEMS Materials Properties, Microelectronic Technology for MEMS, Micromachining Technology for MEMS, Micromachining Process, Etch Stop Techniques and Microstructure, Surface and Quartz Micromachining, Fabrication of Micromachined Microstructure, Microstereolithography
MEMS Microsensors –Design, Principle and Technology- Thermal, Micromachined Microsensors – Mechanical, MEMS Pressure and Flow Sensor, Micromachined Flow Sensors, MEMS Inertial Sensors, Micromachined Microaccelerometers for MEMS
MEMS Accelerometers - Design, Principle and Technology- Temperature Drift and Damping Analysis
Piezoresistive Accelerometers - Design, Principle and Technology- MEMS Capacitive Accelerometer, MEMS Capacitive Accelerometer Process, MEMS Gyro Sensor
MEMS for Space Application, Polymer MEMS & Carbon Nano Tubes, Wafer Bonding & Packaging of MEMS
Interface Electronics for MEMS, MEMS for Biomedical Applications (Bio-MEMS), Introduction to RF MEMS and Nano Electro Mechanical Systems (NEMS)

Text books and References:

1. Fundamentals of Microfabrication: The Science of Miniaturization, 2nd ed., M. J. Madou, published by CRC Press, 2002
2. MEMS and NEMS: Systems, Devices, and Structures [Hardcover], Sergey Edward Lyshevski CRC Press; 2008
3. Practical MEMS: Design of microsystems, accelerometers, gyroscopes, RF MEMS, optical MEMS, and microfluidic systems, Ville Kaajakari, Small Gear Publishing, 2009
4. MEMS & Microsystems: Design, Manufacture, and Nanoscale Engineering, 2nd Edition, Tai-Ran Hsu, McGraw Hill, March 2008
5. Fundamentals of Microfabrication and Nanotechnology, Third Edition, Three-Volume Set, Marc J. Madou, CRC Press, 2011
