Major Specialization: Thermal Engineering							
Mechanical Engineering							
SWAYAM/NPTEL Course List							
Sr. No.	**Semester**	**Name of Course**	**Teaching Scheme**	**Duration**	**Instructor**	**Organizing Institute**	**Credits**
1	V	Heat Exchangers: Fundamentals and Design Analysis	4hrs/week	12 Weeks	Prof. Prasanta Kumar Das, Prof. Indranil Ghosh	IIT KGP	4
2	V	Energy Conservation and Waste Heat Recovery	4hrs/week	12 Weeks	Prof. Prasnata Kumar Das, Prof. A. Battacharya	IIT KGP	4
3	VI	Refrigeration and Air-conditioning	4hrs/week	08 Weeks	Prof. Ravi Kuma	IIT Roorkee	4
4	VI	Solar Energy Engineering and Technology	4hrs/week	12 Weeks	Prof. Pankaj Kalita	IIT Guwahati	4
5	VII	Soft Skills for Business Negotiations and Business Strategies	4hrs/week	12 Weeks	Prof. Uttam Kumar Banarjee	IIT KGP	4

Note:

1) **Minimum 8 to 12 week course is required to allot 4 credits for the course.**
2) **Structure should be uniform , across all branches.**

Heat Exchangers: Fundamentals and Design Analysis

By Prof. Prasanta Kumar Das, Prof. Indranil Ghosh | IIT Kharagpur, 12 Weeks

COURSE LAYOUT

Week 1: Background, Application, Classification, Common terminologies.

Week 2: Introduction to Thermal and hydraulic aspects, pressure drop and heat transfer, sizing and rating. F-LMTD and -NTU method.

Week 3: Tubular Heat Exchangers: different designs, brief description of Shell and Tube Heat Exchangers, Special types.

Week 4: Compact heat exchangers, enhancement of heat transfer, extended surface or Fin, fundamental of extended surface heat transfer,Fin tube heat exchanger

Week 5: Plate Fin Heat Exchangers (PFHE), types, construction, fabrication, design, application. Multistream PFHE.

Week 6: Multistream PFHE continued. Direct contact heat exchangers, types, application, simple analysis.

Week 7: Regenerators, types of regenerators, construction, application. Theory of Regenerator, -NTU and - method.

Week 8: Heat pipes, construction, working principle, application, analysis. Special heat pipes.

Week 9: Microscale Heat Exchangers and heat sinks; heat transfer and fluid flow through narrow conduits, special design considerations

Week 10: Phase change HEX; phase change heat transfer, introduction to evaporators and condensers.

Week 11: Phase change HEX; phase change heat transfer, introduction to evaporators and condensers.

Week 12: Heat Exchanger testing, steady state and dynamic methods.

BOOKS AND REFERENCES

1) Fundamentals of Heat Exchanger Design by R. K. Shah, Dusan P. Sekulic, John Wiley & Sons, 11-Aug-2003.
(2) Heat Exchanger Design Handbook by Kuppan Thulukkanam, Taylor & Francis, 23-Feb-2000.

(3) Heat Exchangers: Selection, Rating, and Thermal Design, Third Edition by Sadik Kakac, Hongtan Liu, CRC-Press, 01-Feb-1998.
(4) Cryogenic Heat Transfer, Second Edition by Randall F. Barron, Gregory F. Nellis, CRC Press, May 23, 2016.

Energy conservation and waste heat recovery

By Prof. Prasanta Kumar Das, Prof. A Bhattacharya | IIT Kharagpur, 12 Weeks

COURSE LAYOUT

Week 1: Introduction to Waste Heat, Importance of Waste Heat Recovery, Review of Thermodynamics – Introduction to First and Second Laws
Week 2: Review of Thermodynamics – Entropy, Entropy Generation, First and Second Law efficiency
Week 3: Power Plant Cycles - Energy Cascading, Rankine Cycle, modification of Rankine cycle, examples
Week 4: Gas Turbine Cycle, Combined Cycle, Combined Gas Turbine-Steam Turbine Power Plant, Heat Recovery Steam Generators
Week 5: Thermodynamic cycles for low temperature application, Cogenerations, Introduction to Heat Exchangers, Analysis – LMTD and ε-NTU method
Week 6: Analysis of Heat Exchanger – continued, Problem solving, Special Heat Exchangers for Waste Heat Recovery, Synthesis of Heat Exchanger Network
Week 7: Heat pipes & Vapor Chambers, Direct conversion technologies – Thermoelectric Generators.
Week 8: Direct conversion technologies – Thermoelectric Generators (contd.), Thermoionic conversion, Thermo-PV, MHD
Week 9: Heat Pump; Heat Recovery from Incinerators, Energy Storage – Introduction.
Week 10: Energy Storage Techniques – Pumped hydro, Compressed Air, Flywheel, Superconducting Magnetic storage
Week 11: Energy Storage Techniques – Thermal storage (Sensible & Latent), Battery, Chemical Energy Storage, Fuel cells.
Week 12: Energy Economics

Refrigeration and air-conditioning

By Prof. Ravi Kumar | IIT Roorkee, 8 Weeks

COURSE LAYOUT

Week-1: Recapitulation of Thermodynamics, Introduction to Refrigeration, Air Refrigeration Cycle, Aircraft Refrigeration Cycles.

Week-2: Aircraft Refrigeration Cycles,Vapour Compression Cycle,P-h Charts, Actual Vapour Compression Cycle

Week-3: Actual Vapour Compression Cycle,Compound Compression with Intercooling, Multiple Evaporator and Cascade System, Problem Solving

Week-4: Refrigerants, Vpour Absorption Systems.

Week-5: Introduction to Air-conditioning, Properties of Moist Air, Psychrometric Chart, Psychrometric Processes.

Week-6: Psychrometric Processes, Infiltration Design Conditions, Cooling Load.

Week-7: Cooling Load, Air Distribution System, Problem Solving, Air-Conditioning Systems

Week-8: Human Physiology, Thermal Comfort, Indoor Environmental Health, Problem Solving

BOOKS AND REFERENCES

1. Refrigeration & Air-conditioning, CP Arora, TMG
2. Refrigeration & Air-conditioning, Manohar Prasad, NAI
3. Refrigeration & Air-conditioning, Stoecker & Jons, MGH
4. Principles of Refrigeration, RC Dosset, LPE
5. ASHRAE Handbook (Fundamentals), ASHRAE

Solar Energy Engineering and Technology

By Prof. Pankaj Kalita | IIT Guwahati, 12 Weeks

COURSE LAYOUT

Week 1: Energy Scenario, overview of solar energy conversion devices and applications, physics of propagation of solar radiation from the sun to earth
Week 2: Sun-Earth Geometry, Extra-Terrestrial and Terrestrial Radiation, Solar energy measuring instruments
Week 3: Estimation of solar radiation under different climatic conditions, Estimation of total radiation
Week 4: Fundamentals of solar PV cells, principles and performance analysis, modules, arrays, theoretical maximum power generation from PV cells.
Week 5: PV standalone system components, Standalone PV-system design.
Week 6: Components of grid-connected PV system, solar power plant design and performance analysis.
Week 7: Fundamentals of solar collectors, Snails law, Bougers law, Physical significance of Transmissivity – absorptivity product.
Week 8: Performance anlaysis of Liquid flat plate collectors and testing
Week 9: Performance anlaysis of Solar Air heaters and testing
Week 10: Solar thermal power generation (Solar concentrators).
Week 11: Thermal Energy Storage (sensible, latent and thermochemical) and solar pond
Week 12: Applications: Solar Refrigeration, Passive architecture,solar distillation, and ermeging technologies.

BOOKS AND REFERENCES

1. G. N. Tiwari, Solar Energy, Fundamentals, Design, Modeling and Applications, Narosa, 2002.
2. S. P. Sukhatme and J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill, 2006.
3. C. S. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, Prentice Hall India, 2nd Edition, 2011.
4. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley, 2006.
5. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, 1999.

6. H. P. Garg and J. Prakash, Solar Energy: Fundamentals and Applications, Tata McGraw Hill, 1997.
7. M. A. Green, Third Generation Photovoltaics: Advanced Solar Energy Conversion, Springer, 2003.

Soft Skills For Business Negotiations And Marketing Strategies

By Prof. Uttam Kumar Banerjee | IIT Kharagpur, 12 Weeks

COURSE LAYOUT

Week 1: Soft Skills and Hard Skills
Week 2: Non-verbal communications
Week 3: Negotiations
Week 4: Professional Negotiations
Week 5: Business Negotiation
Week 6: Product Marketing Negotiation
Week 7: Negotiation for Services
Week 8: Marketing Strategy
Week 9: Power Marketing
Week 10: Power Marketing Strategies
Week 11: Power Marketing Presentations
Week 12: Time Management in Marketing

BOOKS AND REFERENCES

1. Selling and Sales Management – Third Edition by Geoffrey Lancaster & David Jobber, Macmillan India Limited, 1994
2. Harvard Business Essentials - Negotiation, Harvard Business School Publishing Corporation, 2003
3. Management Communication – A Case Analysis Approach – Fifth Edition, James S. O'Rourke, IV, Pearson, 2013
4. Business Communication, Peter Hartley and Clive G. Bruckmann, Routledge, UK, 2002