Annexure – III

Beant College of Engineering & Technology, Gurdaspur

Scheme-M. Tech. Thermal Engineering (Batch 2018 & onwards)

L – Lecture; T – Tutorial; P – Practical

Semester-I							Marks	
S. No.	Course Type/Code	Course Name	L	T	P	Credits	Internal	External
1.	Core-I TH-18101	Thermodynamics and Combustion	3	-	-	3	50	100
2.	Core-II TH-18102	Advanced Fluid Dynamics	3	-	-	3	50	100
3.	Core TH-18103	Research Methodology and IPR	2	-	-	2	50	100
4.	Core Lab-I TH-18104	Thermal Engineering Lab Practice-I	-	-	4	2	100	-
5.	Core Lab-II TH-18105	Thermal Engineering Lab Practice-II	-		4	2	100	-
6.	Programme Elective-I TH-18301 TH-18302	1. Nuclear Engineering 2. Energy Conservation and Management	3	-	-	3	50	100
7.	Programme Elective-II TH-18303 TH-18304	1. Air Conditioning System Design 2. Gas Turbines	3	-	-	3	50	100
8.	Audit	Audit Course-1	2	-	-	0	-	-
		Total	**16**	**-**	**8**	**18**	**450**	**500**

21/5/18

21/05/18

21.05.2018
(Prof. JA Vaz)

21.05.18
(Dr. Subhash Chander)

Semester-II							Marks	
S. No.	Course Type/Code	Course Name	L	T	P	Credits	Internal	External
1.	Core-III TH-18201	Advanced Heat Transfer	3	-	-	3	50	100
2.	Core-IV TH-18202	Steam Engineering	3	-	-	3	50	100
3.	Core TH-18203	Mini-Project	-	-	4	2	100	-
4.	Core Lab-III TH-18204	Thermal Engineering -III	-	-	4	2	100	-
5.	Core Lab-IV TH-18205	Thermal Engineering-IV	-	-	4	2	100	-
6.	Programme Elective-III TH-18305 TH-18306	1. Refrigeration and cryogenics 2. Design of Heat Exchangers	3	-	-	3	50	100
7.	Programme Elective-IV TH-18307 TH-18308	1. Computational Fluid Dynamics 2. Modelling of IC Engines	3	-	-	3	50	100
8.	Audit	Audit-2	2	-	-	0	-	-
		Total	**14**	**-**	**12**	**18**	**500**	**400**

Semester-III							Marks	
S. No.	Course Type/Code	Course Name	L	T	P	Credits	Internal	External
1.	Programme Elective-V TH-18119 TH-18120	1. Design of Solar and Wind System 2. Advanced Mathematical Methods in Engineering	3	-	-	3	50	100
2.	Open Elective TH-18401	1. Business Analytics 2. Industrial	3	-	-	3	50	100

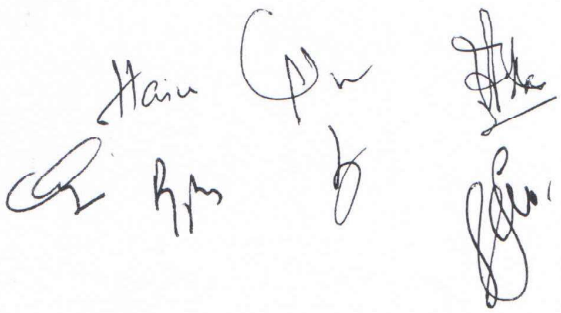
	TH-18402 TH-18403 TH-18404 TH-18405 TH-18406	Safety 3. Operations Research 4. Cost Management of Engineering Projects 5. Composite Materials 6. Waste to Energy						
3.	Dissertation TH-18601	Dissertation Phase-I	-	-	2	10	200	300
		Total	**6**	**-**	**-**	**16**	**300**	**500**

Semester-IV							**Marks**	
S. No.	**Course Type/Code**	**Course Name**	**L**	**T**	**P**	**Credits**	**Internal**	**External**
1.	Dissertation TH-18136	Dissertation Phase-II	-	-	32	16	300	500
		Total	**-**	**-**	**32**	**16**	**300**	**500**

Total credits for the programme = 18+18 +16 +16 = **68**

Total marks for the programme = 3450

Audit course 1 & 2	**Code**
1. English for Research Paper Writing	TH-18501
2. Disaster Management	TH-18501
3. Sanskrit for Technical Knowledge	TH-18503
4. Value Education	TH-18504
5. Constitution of India	TH-18505
6. Pedagogy Studies	TH-18506
7. Stress Management by Yoga	TH-18507
8. Personality Development through Life Enlightenment Skills.	TH-18508



Annexure - IV

BEANT COLLEGE OF ENGINEERING AND TECHNOLOGY GURDASPUR
Department of Mechanical Engineering

Revised Programme Educational Objectives and Programme Outcomes

Programme Educational Objectives

1. To prepare students for successful career in national and international organizations engaged in mechanical & allied engineering systems giving due consideration to cultural, social and environmental issues.
2. To develop the ability amongst students to understand and synthesize data/information and communicate technical concepts effectively.
3. To prepare students to lead/work as a part of team on multidisciplinary projects using latest engineering tools with professional ethics.
4. To develop the ability of life log learning amongst the graduates through research and self learning.

Programme Outcomes

a. Graduates will be able to use the basic knowledge of mathematics, science and mechanical engineering fundamentals for various engineering applications.
b. Graduates will be able to identify, formulate and solve mechanical engineering problems.
c. Graduates will be able to design & conduct experiments, interpret & analyze data and report results & conclusions.
d. Graduates will be able to conceptualize and design various mechanical engineering systems or processes, giving due consideration to health & safety, cultural, social and environmental issues.
e. Graduates will be able to work as an individual and as a team leader/member to complete multidisciplinary tasks efficiently and effectively.
f. Graduates will have ability to serve the society with professional ethics and moral responsibility.
g. Graduates will be capable of continuous self learning by adapting to fast technological changes, leading to life-long learning.
h. Graduates will have an understanding of the impact of engineering on society and demonstrate awareness of contemporary issues.
i. Graduates will be able to use modern software tools & equipment to solve complex mechanical engineering problems.
j. Graduate will have the confidence to optimize available engineering/financial/human resources and manage projects in multi-disciplinary environment as member/leader using engineering and management principles.
k. Graduates will be able to demonstrate effective interpersonal oral &written communication skills, comprehension and report writing.
l. Graduates will be able to bring out sustainable solutions for various mechanical engineering problems giving due consideration to society and environment.

21/5/18 21.05.2018 21.05.18

(Dr. Joseph Anand Vaz) NIT Jalandhar

(Dr. Subhash Chander)

Thermodynamics and Combustion

L T P
3 0 0

Course Outcomes:

1. To recognize exergy, basic laws governing energy conversion in multi-component systems and application of chemical thermodynamics.
2. To apply advanced concepts in thermodynamics with emphasis on thermodynamic relations, equilibrium and stability of multiphase multi-component systems.
3. To describe the molecular basis of thermodynamics.
4. To present theoretical, semi-theoretical and empirical models for the prediction of thermodynamic properties.
5. To acquire the confidence in analyze the motion of combusting and non-combusting fluids whilst accounting for variable specific heats, non-ideal gas properties, chemical non-equilibrium and compressibility
6. To apply the fundamental principles of thermodynamics to non-ideal models of numerous engineering devices
7. To use a systems approach to simplify a complex problem

Syllabus Contents:

- First law and State postulates, Second law and Entropy, Availability and Irreversibility, Transient flow analysis
- Nonreactive Ideal-Gas Mixture, PVT Behavior of Real gases and Real Gas mixture Generalized Thermodynamic Relationship
- Combustion and Thermo-chemistry, Second law analysis of reacting mixture, Availability analysis of reacting mixture, Chemical equilibrium
- Statistical thermodynamics, statistical interpretations of first and second law and Entropy, Third law of thermodynamics, Nerst heat theorem.

Text/Reference Books:

1. Cengel, “Thermodynamics”, Tata McGraw Hill Co., New Delhi, 1980.
2. Howell and Dedcius, “Fundamentals of Engineering Thermodynamics”, McGraw Hill Inc., U.S.A.
3. Van Wylen & Sonntag, “Thermodynamics”, John Wiley and Sons Inc., U.S.A.
4. Jones and Hawkings, “Engineering Thermodynamics”, John Wiley and Sons Inc., U.S.A, 2004.
5. Holman, “Thermodynamics”, McGraw Hill Inc., New York, 2002.
6. Faires V.M. and Simmag, “Thermodynamics”, Macmillan Publishing Co. Inc., U.S.A.
7. Rao Y.V.C., “Postulational and Statistical Thermodynamics”, Allied Publishers Inc, 1994.

Advanced Fluid Dynamics

L T P
3 0 0

Course Outcomes:

1. To identify and define the fluid flow problems along with range of governing parameters
2. To take up the fluid flow problems of industrial base.
3. To devise the experiments in the field of fluid mechanics.
4. To recognize the flow patterns and differentiate between the flow regimes and its effects.

Syllabus Contents:

- Governing equations in Fluid Dynamics: Derivation of Continuity and Momentum equations using integral and differential approach, dimensionless form of governing equations, special forms of governing equations, integral quantities
- Exact Solutions of Navier-Stokes Equations: Fully developed flows, parallel flow in straight channel, Couette flow, Creeping flows
- Potential Flow: Kelvin's theorem, Irrotational flow, Stream function-vorticity approach,
- Laminar Boundary layers: Boundary layer equations, flow over flat plate, Momentum integral equation for boundary layer, approximate solution methodology for boundary layer equations
- Turbulent Flow: Characteristics of turbulent flow, laminar turbulent transition, time mean motion and fluctuations, derivation of governing equations for turbulent flow, shear stress models, universal velocity distribution
- Experimental Techniques: Role of experiments in fluid, layout of fluid flow experiments, sources of error in experiments, data analysis, design of experiments, review of probes and transducers, Introduction to Hot wire Anemometry, Laser Doppler Velocimetry and Particle Image Velocimetry

Text/Reference Books:

1. Muralidhar and Biswas, Advanced Engineering Fluid Mechanics, , Alpha Science International, 2005
2. Irwin Shames, Mechanics of Fluids, , McGraw Hill, 2003
3. Fox R.W., McDonald A.T , Introduction to Fluid Mechanics, John Wiley and Sons Inc, 1985
4. Pijush K. Kundu, Ira M Kohen and David R. Dawaling, Fluid Mechanics, Fifth Edition, 2005

Nuclear Engineering

L T P
3 0 0

Course Outcomes:

1. To describe the basic concepts and processes taking place inside a nuclear reactor, such as nuclear fission, neutron production, scattering, diffusion, slowing down and absorption.
2. To explain concepts of reactor criticality, the relationship between the dimension and fissile material concentration in a critical geometry.
3. To describe Time dependent (transient) behaviour of power reactor in non-steady state operation and the means to control the reactor.
4. To explain concepts of heat removal from reactor core, reactor safety and radiation protection.

Syllabus Content:

- Basics of nuclear fission and power from fission
- Radioactivity, nuclear reactions, cross sections, nuclear fission, power from fission, conversion and breeding
- Neutron transport and diffusion
- Neutron transport equation, diffusion theory approximation, Fick's law, solutions to diffusion equation for point source, planar source, etc., energy loss in elastic collisions, neutron slowing down
- Multigroup, multiregion diffusion equation, concept of criticality
- Solution of multigroup diffusion equations in one region and multiregion reactors, concept of criticality of thermal reactors
- Reactor kinetics and control
- Derivation of point kinetics equations, inhour equation, solutions for simple cases of reactivity additions, fission product poison, reactivity coefficients
- Heat removal from reactor core
- Solution of heat transfer equation in reactor core, temperature distribution, critical heat flux
- Reactor safety, radiation protection

- Reactor safety philosophy, defence in depth, units of radioactivity exposure, radiation protection standards

Text/Reference Books:

1. Introduction to Nuclear Engineering (3rd Edition) by John R. Lamarsh, Anthony J.Barrata, Prentice Hall, (2001)
2. Introduction to Nuclear Reactor Theory, by John R. Lamarsh, Addison-Wesley, 1966)
3. Nuclear Reactor Analysis, by James J. Duderstadt and Lewis J. Hamilton, John Wiley(1976)

Energy Conservation and Management

L T P
3 0 0

Course Outcomes:

1. To acquire insight about the importance of energy
2. To analyze all scenarios from energy consumption
3. To generate scenarios of energy consumption and predict the future trend
4. To Suggest and plan energy conservation solutions

Syllabus Content:

- The energy market, energy scenario, planning, utilization pattern and future strategy, Importance of energy management.
- Energy auditing- methodology and analysis, Energy economics,
- Energy conservation in industries, Cogeneration, Combined heating and power systems, Relevant international standards and laws.

Text/Reference Books:

1. L.C. Witte, P.S. Schmidt, D.R.Brown, "Industrial Energy Management and Utilization", Hemispherical Publication, 1988.
2. Callaghan "Energy Conservation".
3. D.A. Reeg, "Industrial Energy Conservation", Pergamon Press, 1980.
4. T.L. Boyen, "Thermal Energy Recovery" Wiley, 1980.
5. L.J. Nagrath, "Systems Modeling and Analysis", Tata McGraw Hill, 1982.
6. W.C. Turner, "Energy Management Handbook ", Wiley, New York, 1982.
7. I.G.C. Dryden, "The Efficient Use of Energy ", Butterworth, London, 1982.
8. R. Loftnen, Van Nostrarid Reinhold C. "Energy Handbook", 1978.
9. TERI Publications.

Air conditioning system Design

L T P
3 0 0

Course Outcomes:

1. To describe construction and design features Air-conditioning system.
2. To explain various types and its adoptability in the various environment and application areas.
3. To describe various health issues
4. To design seasonal energy efficient system

Syllabus Contents:

- Air conditioning systems,
- various air-conditioning processes,
- Enthalpy deviation curve, psychrometry , SHF, dehumidified air quantity, human comfort, indoor air quality,
- Design conditions and load calculations, air distribution, pressure drop, duct design, fans &, blowers,
- Performance & selection, noise control.

Text/Reference Books:

1. ASHRAE Handbook.
2. "Handbook of air-conditioning system design", Carrier Incorporation, McGraw Hill Book Co.,
3. U.S.A, 1965.
4. "Refrigeration and air-conditioning", ARI, Prentice Hall, New Delhi, 1993.
5. Norman C. Harris, "Modern Air Conditioning", New York, McGraw-Hill,1974.
6. Jones W.P., "Air Conditioning Engineering", Edward Arnold Publishers Ltd., London, 1984.
7. Hainer R.W., "Control Systems for Heating, Ventilation and Air-Conditioning", Van Nostrand
8. Reinhold Co., New York, 1984. 7. Arora C.P., "Refrigeration & Air Conditioning", Tata Mc Graw Hill, 1985.
9. Manohar Prasad, "Refrigeration & Air Conditioning", New Age Publishers.
10. Stoecker, "Refrigeration & Air Conditioning", Mc Graw Hill, 1992.
11. Stoecker, "Design of Thermal Systems", Mc Graw Hill, 1992.

Gas Turbines

L T P
3 0 0

Course Outcomes:

1. To recognize construction and design features of gas turbines as used for power generation.
2. To explain thermodynamics cycles a, and different sizes and layouts of gas turbine plant
3. To describe thermodynamics and fluid mechanics component for enhancing the efficiency and effectively of gas turbines

Syllabus Contents:

- Introduction, Cycles, Performance characteristics and improvement,
- Gas dynamics, Centrifugal, axial and mixed flow compressor, principles and characteristics, Turbine construction, Blade materials, manufacturing techniques, blade fixing,
- Problems of high temperature operation, blade cooling, practical air cooled blades Combustion Systems, various fuels and fuel systems,
- Jet propulsion cycles and their analysis, parameters affecting performance, thrust augmentation, environmental considerations and applications.

Text/Reference Books:

1. H Cohen, GFC Rogers and HIH Saravanamuttoo, "Gas Turbine Theory", Pearson Education, 2000.
2. V. Ganesan, "Gas Turbines", Tata McGraw Hill, 2003.
3. S.M.Yahya "Turbines, Compressors and Fans", Tata McGraw Hill, 1992.
4. Vincent "The theory and design of Gas Turbine and Jet Engines", McGraw Hill, 1950.
5. W W Bathic, "Fundamentals of Gas Turbines", John Wiley and Sons.

Research Methodology and IPR

L T P
1 0 0

Course Outcomes:

1. To describe research problem formulation. Analyze research related information and follow research ethics.
2. To Recognize that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
3. To differentiate that when IPR would take such important place in growth of individuals & nation, it is needless to emphasise the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
4. To describe that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Syllabus Contents:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysis
Plagiarism, Research ethics,

Unit 3: Effective technical writing, how to write report, Paper
Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

3. Ranjit Kumar, 2 nd Edition, "Research Methodology: A Step by Step Guide for beginners" Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
4. Mayall , "Industrial Design", McGraw Hill, 1992. Niebel , "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Advanced Heat Transfer

L T P
3 0 0

Course Outcomes:

1. To explain the subject of Heat Transfer in detail.
2. To solve Industrial Problems.
3. To carry out the Future Research

Syllabus Contents:

- Conduction- one and two dimensional,
- Fins, conduction with heat source, unsteady state heat transfer,
- Natural and forced convection, integral equation, analysis and analogies,
- Transpiration cooling, ablation heat transfer, boiling, condensation and two phase flow mass transfer, cooling, fluidized bed combustion,
- Heat pipes, Radiation, shape factor, analogy, shields, Radiation of gases & vapours.

Text/Reference Books:

1. J.P. Holman, "Heat Transfer", McGraw Hill Book Company, New York, 1990.
2. Incropera and Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, NewYork, 2000.
3. Frank Kreith, "Principles of Heat Transfer", Harper and Row Publishers, New York, 1973.
4. Donald Q. Kern "Process Heat Transfer", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1975.
5. Gupta and Prakash, "Engineering Heat Transfer", New Chand and Bros, Roorkee (U.P.) India, 1996.
6. R.C. Sachdeva "Fundamentals of Engineering Heat and Mass Transfer", Wiley Eastern Ltd., India,

Steam Engineering

L T P
3 0 0

Course Outcomes:

1. To explain working of different boilers and significance of mountings and accessories.
2. To use techniques, skills, and modern engineering tools necessary for boiler performance assessment.
3. To recognize energy conservation fundamentals to analyze thermal systems for energy conservation.
4. To design a steam piping system, its components for a process and also design economical and effective insulation.
5. To analyze a thermal system for sources of waste heat design a systems for waste heat recovery.
6. To design and develop controls and instrumentation for effective monitoring of the process.

Syllabus Contents:

Introduction
Fundamentals of steam generation, Quality of steam, Use of steam table, Mollier Chart Boilers ,Types, Mountings and Accessories, Combustion in boilers, Determination of adiabatic flame temperature, quantity of flue gases, Feed Water and its quality, Blow down; IBR, Boiler standards

Piping & Insulation
Water Line, Steam line design and insulation; Insulation-types and application, Economic thickness of insulation, Heat savings and application criteria, Refractory-types, selection and application of refractory, Heat loss.

Steam Systems
Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Steam Engineering Practices; Steam Based Equipments / Systems.

Boiler Performance Assessment
Performance Test codes and procedure, Boiler Efficiency, Analysis of losses; performance evaluation of accessories; factors affecting boiler performance.

Energy Conservation and Waste Minimization
Energy conservation options in Boiler; waste minimization, methodology; economical viability of waste minimization

Instrumentation & Control

Process instrumentation; control and monitoring. Flow, pressure and temperature measuring and controlling instruments, its selection

Text/Reference Books:

1. T. D. Estop, A. McConkey, Applied Thermodynamics, Parson Publication
2. Domkundwar; A Course in Power Plant Engineering; Dhanapat Rai and Sons
3. Yunus A. Cengel and Boles, "Engineering Thermodynamics ",Tata McGraw-Hill Publishing Co. Ltd
4. Book II - Energy Efficiency in Thermal Utilities; Bureau of Energy Efficiency
5. Book IV - Energy Performance Assessment for Equipment & Utility Systems; Bureau of Energy Efficiency
6. Edited by J. B. Kitto & S C Stultz; Steam: Its Generation and Use; The Babcock and Wilcox Company
7. P. Chatopadhyay; Boiler Operation Engineering: Questions and Answes; Tata McGrawHill Education Pvt Ltd, N Delhi

Refrigeration and Cryogenics

L T P
3 0 0

Course Outcomes:

1. To learn the basics of refrigeration and cryogenics and its application area.
2. To design the refrigeration systems for domestic and industrial applications like cold storages
3. To learn about ODP, GWP and related environment issues

Syllabus Contents:

- Vapour compression refrigeration, actual cycle, second law efficiency,
- Multistage compression with inter-cooling, Multi-evaporator systems, Cascade systems,
- Performance characteristics and capacity control of reciprocating and centrifugal compressors, screw compressor and scroll compressor,
- Design, selection of evaporators, condensers, control systems, motor selection, Refrigerants, alternative refrigerants, CFC/HCFC phase-out regulations,
- Refrigeration applications, food preservation, transport,
- Introduction to Vapor absorption refrigeration, single effect and double effect systems, Gas liquefaction systems - Linde-Hampson, Linde dual pressure, Claude cycle.

Text/Reference Books:

1. R.J.Dossat, “Principles of Refrigeration”, Pearson Education Asia, 2001.
2. C.P.Arora, “Refrigeration and Air-conditioning”, Tata McGraw-Hill, 2000.
3. Stoecker & Jones, “Refrigeration and Air-conditioning”, McGraw Hill Book Company, New York, 1982.
4. Jordan & Priester, “Refrigeration and Air-conditioning”.
5. A.R.Trott, “Refrigeration and Air-conditioning”, Butterworths, 2000.
6. J.L.Threlkeld, “Thermal Environmental Engineering”, Prentice Hall, 1970.
7. R.Barron, “Cryogenic systems”, McGraw–Hill Company, New Yourk, 1985.
8. G.G.Hasseldon. “Cryogenic Fundamentals”, Academic Press.
9. Bailey, “Advanced Cryogenics”, Plenum Press, London, 1971.
10. W.F.Stoecker, “Industrial Refrigeration Handbook”, McGraw-Hill, 1998.
11. John A.Corinchock, “Technician’s Guide to Refrigeration systems”, McGrawHill.
12. P.C.Koelet, “Industrial Refrigeration: Principles, Design and Applications”, Macmillan, 1992.
13. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration.

14. Graham Walker, "Miniature Refrigerators for Cryogenic Sensors and Cold Electronics", Clarendon Press, 1989

Design of Heat Exchangers

L T P
3 0 0

Course Outcomes:

1. To demonstrate a basic understanding of several types of heat exchangers that will include shell-and-tube, double pipe, plate-and-frame, finned tube, and plate-fin heat exchangers, Heat pipes.
2. To design and analyses of shell-and-tube double pipe, compact, plate heat exchangers.
3. To demonstrate the performance degradation of heat exchangers subject to fouling.

Syllabus Contents:

- Heat Exchangers – Classification according to transfer process, number of fluids, surface compactness, and construction features. Tubular heat exchanger, plate type heat exchangers, extended surface heat exchangers, heat pipe, Regenerators. Classification according to flow arrangement: counter flow, parallel flow, cross flow exchanger.

- Heat exchanger design methodology, assumption for heat transfer analysis, problem formulation, e-NTU method, P-NTU method, Mean temperature difference method, fouling of heat exchanger, effects of fouling, categories of fouling, fundamental processes of fouling.

- Double Pipe Heat xchangers: Thermal and Hydraulic design of inner tube, Thermal and hydraulic analysis of Annulus, Total pressure drop

- Compact Heat Exchangers: Thermal and Hydraulic design of compact heat exchanger

- Shell and Tube heat exchangers – Tinker's, kern's, and Bell Delaware's methods, for thermal and hydraulic design of Shell and Tube heat exchangers

- Mechanical Design of Heat Exchangers – design standards and codes, key terms in heat exchanger design, material selection, and thickness calculation for major components such as tube sheet, shell, tubes, flanges and nozzles. Introduction to simulation and optimization of heat exchangers, flow induced vibrations.

Text/Reference Books:

1. Ramesh K. Shah and Dusan P. Sekulic, "Fundamentals of Heat Exchanger Design" John Wiley & sons Inc., 2003.
2. D.C. Kern, "Process Heat Transfer", McGraw Hill, 1950.

3. Sadik Kakac and Hongton Liu, “Heat Exchangers: Selection, Rating and Thermal Design” CRC Press, 1998.
4. A .P. Frass and M.N. Ozisik, “Heat Exchanger Design”, McGraw Hill, 1984
5. Afgan N. and Schlinder E.V. “Heat Exchanger Design and Theory Source Book”.
6. T. Kuppan, “Hand Book of Heat Exchanger Design”.
7. “T.E.M.A. Standard”, New York, 1999.
8. G. Walkers, “Industrial Heat Exchangers-A Basic Guide”, McGraw Hill, 1982.

Computational Fluid Dynamics

L T P
3 1 0

Course Outcomes:

1. To describe the subject of Computational Fluid Dynamics.
2. To know how to use it as tool to solve the Heat Transfer and Fluid Mechanics related Industrial Problems.
3. To carry out the Future Research.

Syllabus Contents:

- Introduction to CFD: with experimental and Hyperbolic Equations.
- Computational approach to Fluid Dynamics and its comparison analytical methods, Basics of PDE: Elliptic, Parabolic and
- Governing Equations: Review of Navier-Stokes Equation and simplified forms, Solution Methodology: FDM and FVM with special emphasis on FVM, Stability, Convergence and Accuracy.
- Finite Volume Method: Domain discretization, types of mesh and quality of mesh, SIMPLE, pressure velocity coupling, Checkerboard pressure field and staggered grid approach
- Geometry Modeling and Grid Generation: Practical aspects of computational modeling of flow domains, Grid Generation, Types of mesh and selection criteria, Mesh quality, Key parameters and their importance
- Methodology of CFDHT: Objectives and importance of CFDHT, CFDHT for Diffusion Equation, Convection Equation and Convection-Diffusion Equation
- Solution of N-S Equations for Incompressible Flows: Semi-Explicit and Semi-Implicit Algorithms for Staggered Grid System and Non Staggered Grid System of N-S Equations for Incompressible Flows

Text/Reference Books:

1. Computational Fluid Dynamics, The Basic with applications by John A. Anderson, Jr., McGraw Hill International editions, Mechanical Engineering series.

2. Numerical Methods in Fluid Flow & Heat Transfer by Dr. Suhas Patankar.
3. An Introduction to Computational Fluid Flow (Finite Volume Method), by H.K. Versteeg, W.Malalasekera, Printice Hall
4. Computational Methods for Fluid Dynamics by Ferziger and Peric, Springer Publication.

5. An Introduction to Computational Fluid Mechanics by Chuen-Yen Chow, Wiley Publication.
6. Computational Fluid Flow & Heat Transfer by Murlidhar and Sundarrajan, Narosa Publication.

Modelling of IC Engine

L T P
3 0 0

Course Outcomes:

1. To demonstrate a basic understanding of several types of engine models that will include zero dimensional thermodynamic model, one dimensional and multi-dimensional, single zone, two zone etc models.
2. To develop models and simulate them for diesel engine petrol engine, gas engine.
3. To demonstrate the performance evaluation and emission standards for such modeled engines

Syllabus Contents:

- Fundamentals: Governing equations, Equilibrium charts of combustion chemistry, chemical reaction rates, and approaches of modeling, model building and integration methods, gas exchange through valves, engine and porting geometry, exhaust gas recirculation, valve lift curves.

- Thermodynamic Combustion Models of CI Engines: Single zone models, premixed and diffusive combustion models, combustion heat release using wiebe function, wall heat transfer correlations, ignition delay, internal energy estimations, two zone model, application of heat release analysis.

- Fuel spray behavior: Fuel injection, spray structure, fuel atomization, droplet turbulence interactions, droplet impingement on walls.

- Modeling of charging system: Constant pressure and pulse turbo charging, compressor and turbine maps, charge air cooler.

- Mathematical models of SI Engines: Simulation of Otto cycle at full throttle, part throttle and supercharged conditions. Progressive combustion, Autoignition modeling, single zone models, mass burning rate estimation, SI Engine with stratified charge. Friction in pumping, piston assembly, bearings and valve train etc. friction estimation for warm and warm up engines.

Text/Reference Books:

1. Haywood, “I.C. Engines”, Mc Graw Hill.

2. Ramos J (1989) Internal Combustion Engine Modeling. Hemisphere Publishing Company
3. C. D. Rakopoulos and E. G. Giakoumis, “Diesel Engine Transient
4. Operation Principles of Operation and Simulation Analysis”, Springer, 2009.
5. V. Ganeshan, “Internal Combustion Engines”, Tata McGraw Hill, New Delhi, 1996.
6. P.A. Lakshminarayanan and Y. V. Aghav, “ Modelling Diesel Combustion” Springer, 2010
7. Bernard Challen and Rodica Baranescu, “Diesel Engine Reference Book” Butterworth-Heinemann, 1999.

(DCE-III) Design of Solar and Wind Systems

L T P
3 0 0

Course Outcomes:

1. To update about the technological status of implementation of NCES in India
2. To analyze various techno economical obstacles in the commercial development of NCES in India
3. To conceptually model and design general NCES systems and predict the long term performance.
4. To suggest and plan hybrid NCES solutions to conventional energy systems

Syllabus Contents:

- Conventional sources of energy, Nuclear, Alternative energy sources,
- Solar Radiation-estimation, prediction & measurement, Solar energy utilization,
- Performance of Solar flat plate collectors, concentrating collectors, thermal storage, Wind energy, Direct Energy conversion- PV, MHD,
- Fuel cells, thermionic, thermoelectric, Biomass, biogas, hydrogen, Geothermal.

Text/Reference Books:

1. D.Y. Goswami, F. Kreith and J.F. Kreider, "Principle of Solar Engineering", Taylor and Francis, 2000.
2. Sukhatme S.P., "Solar Energy", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1994.
3. Bansal and othes, "Non-Conventional Energy Sources".
4. J.F. Kreider, F. Kreith, "Solar Energy Handbook", McGraw Hill, 1981
5. J.A. Duffie and W.A. Beckman, "Solar Engineering of Thermal Processes", John Wiley, 1991.

Advanced Mathematical Methods in Engineering

L T P
3 1 0

Course Outcomes:

1. To analyse and develop the mathematical model of thermal system.
2. To analyse the reliability and maintainability of the series and paralle thermal system.
3. To solve differential equations using numerical techniques.

Syllabus Contents:

- Ordinary Differential Equations: First-order equations (Linear, Equidimensional, Separable Exact, Homogeneous,); Second-order linear differential equations (homegeneous an nonhomogeneous); Solution methods such as undertermined coefficients and variation o parameters.

- Partial Differential Equations: First order partial differential equations; Second order linea partial differential equations; Canonical forms; Fourier series, Second order equation

- (Parabolic, Elliptic and Hyperbolic) in rectangular, cylindrical polar and spherical coordinate systems; Solution techniques such as separation of variables, eigenfunction expansions, integral transforms (Fourier and Laplace transforms); D'Alembert's solution for the Wave equation; Maximum principle for Elliptic equations; Variational methods for approximate solutions of differential equations.

- Standard discrete and continuous distributions like Binomial, Poisson, Normal, Exponential etc. Central Limit Theorem and its significance. Some sampling distributions like c2, t, F.

- ANOVA: One – way, Two – way with/without interactions, Latin

- Squares ANOVA technique, Principles of Design Of Experiments, some standard designs such as CRD, RBD, LSD.

- Some of the relevant topics required for ANOVA (sample estimates and test hypothesis) may also be included.

Text/Reference Books:

1. J.B. Doshi, “Differential Equations for Scientists and Engineers”, Narosa, 2010.
2. Peter O'Neil, “Advanced Engineering Mathematics”, Seventh Edition, Cengage Learning, 2012 (Indian Edition).
3. Michael Greenberg, “Advanced Engineering Mathematics”, Second Edition, Pearson Education, 2002 (Indian Edition).
4. Jennings. A., Matrix Computation for Engineers and Scientists. John Wiley and Sons, 1992.
5. Prem.K.Kythe, Pratap Puri, Michael R.Schaferkotter, Introduction to Partial Differential Equations and Boundary Value problems with Mathematics, CRC Press, 2002.
6. Kreyszig, Erwin, I.S., Advanced Engineering Mathematics, Wiley, 1999.
7. Ramamurthy. V., Computer Aided Design in Mechanical Engineering., Tata McGraw Hill Publishing Co., 1987
8. Fundamental Concepts in the Design of Experiments, 5th Ed., by Hicks and Turner
9. Devore, Jay L., Probability and Statistics for Engineering and the Sciences, 5th edition, Brooks- Cole (1999)

Mini project

L T P
2 0 0

Course Outcomes:

1. To work in actual industrial environment if they opt for internship.
2. In case of mini project, they will solve a live problem using software/analytical/computational tools.
3. To write technical reports.
4. To develop skills to present and defend their work in front of technically qualified audience.

Syllabus Contents:

Students can take up small problems in the field of design engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Thermal Engineering Lab Practice – I and II

L T P
4 0 0

Course Outcomes:

1. To acquire hands on experience on the various test-rigs, Experimental set up.
2. To measure the various technical parameters by instrument and by mathematical relationship.
3. To identify the effect of various parameters on the system and able to co-relate them.

Syllabus Contents:

- The lab practice consists of the tutorials and experiments as decided by the course supervisors of the Program Core Courses (PCC) namely Fluid Dynamics, Advanced Heat Transfer, Thermodynamics and Combustion, Refrigeration and Cryogenics.

Lab Practice III and IV - Thermal Engineering

L T P
4 0 0

Course Outcomes:

1. To acquire hands on experience on the various test-rigs, Experimental set up.
2. To measure the various technical parameters by instrument and by mathematical relationship.
3. To identify the effect of various parameters on the system and able to co- relate them.

Syllabus Contents:

The lab practice consists of the tutorials and experiments as decided by the course supervisors of the Program Core Courses (PCC) namely Design of Heat Exchangers and Computational Fluid Dynamics, Modelling of I C Engine.

(Dissertation) Dissertation Phase-1

L T P
20 0 0

Course Outcomes:

1. To be exposed to self-learning various topics.
2. To survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
3. To learn to write technical reports.
4. To develop oral and written communication skills to present and defend their work in front of technically qualified audience.

Guidelines:

The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

Dissertation Phase- II

L T P
32 0 0

Course Outcomes:

1. To use different experimental techniques.
2. To use different software/ computational/analytical tools.
3. To design and develop an experimental set up/ equipment/test rig.
4. Tto conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
5. To either work in a research environment or in an industrial environment.
6. To be conversant with technical report writing.
7. To be able to present and convince their topic of study to the engineering community.

Guidelines:

It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. . The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.

OPEN ELECTIVES
Business Analytics

L T P
3 0 0

Course objectives:

1. To Describe the role of business analytics within an organization.
2. To Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To explain how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To explain processes needed to develop, report, and analyze business data.
5. To use decision-making tools/Operations research techniques.
6. To manage business process using analytical and management tools.
7. To analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Outcomes:

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

Syllabus contents:

Unit1:

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics.

Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methodsoverview.

Unit 2:

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression.Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit 3:
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.
Descriptive Analytics, predictive analytics, predicative Modelling, Predictiveanalytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit 4: Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit 5:
Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit 6:
Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

References/Text Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

OPEN ELECTIVES
Industrial Safety

L T P
3 0 0

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Reference/Text Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OPEN ELECTIVES
Operations Research

L T P
3 0 0

Course Outcomes:

1. To apply the dynamic programming to solve problems of discreet and continuous variables.
2. To apply the concept of non-linear programming
3. To carry out sensitivity analysis
4. To model the real world problem and simulate it.

Syllabus Contents:

Unit 1:

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit 2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit 3:

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit 4

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Text/Reference Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008

4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Open Elective
Cost Management of Engineering Projects

L T P
3 0 0

Introduction and Overview of the Strategic Cost Management Process

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Text/Reference Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher

5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Open Elective
Composite Materials

L T P
3 0 0

UNIT–I: INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

Text/Reference Books:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Open Elective
Waste to Energy

L T P
3 0 0

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Text/Reference Books:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

AUDIT 1 and 2: ENGLISH FOR RESEARCH PAPER WRITING

Course objectives:

1. To explain that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. To describe the skills needed when writing a Title
4. To ensure the good quality of paper at very first-time submission

Units	CONTENTS	Hours
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	
4	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	
5	skills are needed when writing the Methods, skills needed when 4 writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

AUDIT 1 and 2: DISASTER MANAGEMENT

Course Objectives: -

1.Tto demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. To critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. To develop the recognition of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. To explain the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Syllabus Contents:

1 Introduction
Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

2 Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills,Outbreaks Of Disease And Epidemics, War And Conflicts.

3 Disaster Prone Areas In India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

4 Disaster Preparedness And Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

5 Risk Assessment Disaster Risk: Concept And Elements, Disaster Risk Reduction, GlobalAnd National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

6 Disaster Mitigation Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Syllabus:

Unit	Content
1	Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences
2	Order Introduction of roots Technical information about Sanskrit Literature
3	Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Reading:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AUDIT 1 and 2: VALUE EDUCATION

Course Objectives:

1. To Explain value of education and self- development
2. To imbibe good values in students
3. To know about the importance of character

Syllabus

1 Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism, Standards and principles, Value judgements

2 Importance of cultivation of values, Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness, Honesty, Humanity. Power of faith, National Unity, Patriotism.Love for nature ,Discipline

3 Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline.Punctuality, Love and Kindness. Avoid fault Thinking.Free from anger, Dignity of labour.Universal brotherhood and religious tolerance. True friendship.Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

4 Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence ,Humility, Role of Women. All religions and same message.Mind your Mind, Self-control. Honesty, Studying effectively

Suggested reading

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes

1.Knowledge of self-development
2.Learn the importance of Human values
3.Developing the overall personality

AUDIT 1 and 2: CONSTITUTION OF INDIA

Course Objectives:

1. To explain the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Syllabus

History of Making of the Indian Constitution:

1 History Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution:

2 Preamble Salient Features Contours of Constitutional Rights & Duties:
Fundamental Rights, Right to Equality, Right to Freedom

3 Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties, Organs of Governance: Parliament, Composition

4 Qualifications and Disqualifications Powers and Functions Executive PresidentGovernor Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

5 Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

6 Election Commission:
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.

4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AUDIT 1 and 2: PEDAGOGY STUDIES

Course Objectives:

1. To review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. To identify critical evidence gaps to guide the development.

Syllabus

Introduction and Methodology:
Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions.

Overview of methodology and Searching.
Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education. Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Theory of change.Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies. Professional development: alignment with classroom practices and follow-up support

Peer support Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes Research gaps and future directions Research design

Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA

Course Objectives

1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

Unit	Content	Hours
1	Definitions of Eight parts of yog. (Ashtanga)	8
2	Yam and Niyam. Do`s and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	8
3	Asan and Pranayam i) Various yog poses and their benefits for mind & body ii)Regularization of breathing techniques and its effects-Types of pranayam	8

Suggested reading

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Outcomes:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objectives

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Syllabus

Unit	Content	Hours
1	Neetisatakam-Holistic development of personality Verses- 19,20,21,22 (wisdom) Verses- 29,31,32 (pride & heroism) Verses- 26,28,63,65 (virtue) Verses- 52,53,59 (dont's) Verses- 71,73,75,78 (do's)	8