Government College of Engineering, Karad

(*an Autonomous Institute of Government of Maharashtra*)

Scheme of Instructions and Syllabus

Scheme of Instructions for First Year M. Tech. course in Heat Power Engineering

Semester – I (w.e.f.: AY 2019-20)

Sr.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs / week	Credits	Exam Scheme				
									CT - 1	CT - 2	TA / CA	ESE	TOTAL
1.	PCC	HP1101	Thermodynamics and Combustion	3	-	-	3	3	15	15	10	60	100
2.	PCC	HP1102	Advanced Heat Transfer	3	-	-	3	3	15	15	10	60	100
3.	PEC	HP11*3	Program Elective - I	3	-	-	3	3	15	15	10	60	100
4.	PEC	HP11*4	Program Elective - II	3	-	-	3	3	15	15	10	60	100
5.	MDC	RM1105	Research Methodology	2	-	-	2	2	15	15	10	60	100
6.	PCC	HP1106	Lab Practice - I	-	-	4	4	2	-	-	25	25	50
7.	PEC	HP1107	Lab Practice - II	-	-	4	4	2	-	-	25	25	50
8.	OEC	OE11*8	Open Elective	3	-	-	3	3	15	15	10	60	100
9.	MNC	AU11*9	Audit Course - I	2	-	-	2	-	-	-	-	-	-
			Total	19	-	8	27	21	90	90	110	410	700

L- Lecture T-Tutorial P-Practical CT1- Class Test 1 CT2- Class Test 2 TA/CA- Teacher Assessment / Continuous Assessment

ESE- End Semester Examination (For Laboratory: End Semester Performance)

*- Program Elective / Audit Course / Open Elective (*list is provided at the end of structure*)

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Scheme of Instructions and Syllabus

Scheme of Instructions for First Year M. Tech. course in Heat Power Engineering

Semester – II (w.e.f.: AY 2019-20)

Sr.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs / week	Credits	Exam Scheme				
									CT - 1	CT - 2	TA / CA	ESE	TOTAL
1.	PCC	HP1201	Advanced Fluid Dynamics	3	-	-	3	3	15	15	10	60	100
2.	PCC	HP1202	Steam Engineering	3	-	-	3	3	15	15	10	60	100
3.	PEC	HP12*3	Program Elective - III	3	-	-	3	3	15	15	10	60	100
4.	PEC	HP12*4	Program Elective – IV	3	-	-	3	3	15	15	10	60	100
5.	PEC	HP12*5	Program Elective - V	3	-	-	3	3	15	15	10	60	100
6.	PCC	HP1206	Lab Practice - III	-	-	4	4	2	-	-	25	25	50
7.	PEC	HE1207	Lab Practice - IV	-	-	4	4	2	-	-	25	25	50
8.	P / S/ IT	HP1208	Seminar on Pre-Dissertation work	-	-	4	4	2	-	-	50	50	100
9.	MNC	AU12*9	Audit Course – II	2	-	-	2	-	-	-	-	-	-
			Total	17	-	12	29	21	90	90	110	410	700

L- Lecture T-Tutorial P-Practical CT1- Class Test 1 CT2- Class Test 2 TA/CA- Teacher Assessment / Continuous Assessment

ESE- End Semester Examination (For Laboratory: End Semester Performance)

*- Program Elective / Audit Course / Open Elective (*list is provided at the end of structure*)

*-Program Elective V - Students are permitted to register online courses available on different online platforms. If student will choose classroom teaching process, then only CT-I. CT-II, ESE will be conducted, otherwise grade will be accepted as given by course offering agency.

Government College of Engineering, Karad

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Scheme of Instructions and Syllabus

Scheme of Instructions for First Year M. Tech. course in Heat Power Engineering

Semester – III (w.e.f.: AY 2019-20)

Sr.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs / week	Credits	Exam Scheme				
									CT - 1	CT - 2	TA / CA	ESE	TOTAL
1.	P / S / IT	HP1301	Dissertation - I	-	-	14	14	07	-	-	100	100	200
2.	PEC	HP1302 **	MOOC online course (8-12 weeks)	-	-	-	-	03	-	-	-	-	-
			Total	-	-	14	14	10	-	-	100	100	200

TA/CA- Teacher Assessment / Continuous Assessment

ESE- End Semester Examination (For Laboratory: End Semester Performance)

** HP1302 is mandatory and will be decided by respective Guide in consultation with Programme Head.

Government College of Engineering, Karad

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Scheme of Instructions and Syllabus

Scheme of Instructions for First Year M. Tech. course in Heat Power Engineering

Semester – IV (w.e.f.: AY 2019-20)

Sr.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs / week	Credits	Exam Scheme				
									CT - 1	CT - 2	TA / CA	ESE	TOTAL
1.	P / S / IT	HP1401	Dissertation - II	-	-	32	32	16	-	-	100*	200	300
			Total	-	-	32	32	16	-	-	100	200	300

TA/CA- Teacher Assessment / Continuous Assessment

ESE- End Semester Examination (For Laboratory: End Semester Performance)

Government College of Engineering, Karad

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Scheme of Instructions and Syllabus

Scheme of Instructions for First Year M. Tech. course in Heat Power Engineering

List of Program Elective Courses

Semester – I			**Semester – II**		
Program Elective - I	**Program Elective - II**		**Program Elective - III**	**Program Elective - VI**	**Program Elective - V**
HP1113: Nuclear Engineering	**HP1114:** Air Conditioning System Design		**HE1213:** Refrigeration and cryogenics	**HP1214:** Computational Fluid Dynamics	**HP1215:** Engineering Experimental Techniques
HP1123: Energy Conservation and Management.	**HP1124:** Gas Turbines		**HP1223:** Design of Heat Exchangers	**HP1124:** Design of Solar and Wind System	**HP1225:** Advanced I. C. Engine
HP1133: Design of Fluid Power Systems	**HP1134:** Advanced Automobile Engineering		**HP1233:** Advanced Mathematical Methods in Engineering	**HP1234:** Energy Analysis of Thermal Systems	**HP1235:** Design of Pump, Compressor and turbine

List of Open Electives and Audit Courses

Semester - I			Semester – II
Open Electives	**Audit Course - I**		**Audit Course - II**
OE1118: Business Analytics	**AU1119:** Research Paper Writing		**AU1219:** Constitution of India
OE1128: Industrial Safety	**AU1129:** Disaster Management		**AU1229:** Pedagogy Studies
OE1138: Operations Research	**AU1139:** Sanskrit for Technical Knowledge		**AU1239:** Stress Management by Yoga
OE1148: Cost Management of Engineering Projects	**AU1149:** Value Education		**AU1249:** Personality Development through Life Enlightenment Skills
OE1158: Composite Materials			
OE1168: Waste to Energy			

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical- Heat Power Engineering

HP 1101: Thermodynamic and Combustion

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of the course:

1.	Student will get Knowledge of exergy, basic laws governing energy conversion in multi-component systems and application of chemical thermodynamics.
2.	Student will be aware about advanced concepts in thermodynamics with emphasis on thermodynamic relations, equilibrium, molecular basis of thermodynamics and stability of multiphase multi-component systems.
3.	To present theoretical, semi-theoretical and empirical models for the prediction of thermodynamic properties.
4.	Student will be 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.
5.	Student should apply the fundamental principles of thermodynamics to non-ideal models of numerous engineering devices.
6.	Student can use a systems approach to simplify a complex problem.

	Course Contents	Hours
Unit 1	**First law and State postulates**- Steady flow and Transient flow analysis, Second law and Entropy, Availability and Irreversibility- Second law analysis- Closed systems, steady flow systems, unsteady flow systems.	**(05)**
Unit 2	**Non-reacting Gas Mixtures**- Composition of a gas mixture, PVT Behavior of Real gases and Real Gas mixture, Properties of gas mixtures. Mixture of Ideal and real gases.	**(06)**
Unit 3	**Generalized Thermodynamic Relationships**- Mathematical theorems, Maxwell relations, Tds equations, Energy Equations, General Relations involving internal energy, enthalpy & entropy, Thermodynamics Relations involving specific heat, Clapeyron equation, Joule Thomson Coefficient, Property relations for real gases, Fugacity.	**(08)**
Unit 4	**Combustion and Thermo-chemistry**- Fuels and combustion, Enthalpy of formation and Enthalpy of reaction, First and Second law analysis of reacting mixture, Availability analysis of reacting mixture, Chemical equilibrium-Equilibrium criterion, Equilibrium constant for ideal gas mixtures, simultaneous reactions.	**(08)**
Unit 5	**Statistical thermodynamics**- Fundamental principles, Equilibrium distribution, significance of Lagrangian multipliers, Partition function of an ideal monatomic gas, equipartition of energy, distribution of speeds in an ideal monatomic gas, , statistical interpretations of work and heat, Entropy and information.	**(07)**
Unit 6	**Chemical Phase Equilibrium**- Single component system, Gibbs phase rule, multicomponent systems, Third law of thermodynamics, Nerst heat theorem.	**(06)**

Tutorials- --

Text Books

1.	Cengel, “Thermodynamics”, Tata McGraw Hill Co., New Delhi, 1980.
2.	Van Wylen & Sonntag, “Thermodynamics”, John Wiley and Sons Inc., U.S.A.
3.	Holman, “Thermodynamics”, McGraw Hill Inc., New York, 2002.

Reference Books

1.	Howell and Dedcius, “Fundamentals of Engineering Thermodynamics”, McGraw Hill Inc.,U.S.A.
2.	Jones and Hawkings, “Engineering Thermodynamics”, John Wiley and Sons Inc., U.S.A,2004.
3.	Faires V.M. and Simmag, “Thermodynamics”, Macmillan Publishing Co. Inc., U.S.A.
4.	Rao Y.V.C., “Postulational and Statistical Thermodynamics”, Allied Publishers Inc, 1994.

Useful Links

1.	https://nptel.ac.in/courses/101104014/pdf_lecture
2.	https://www.edx.org/learn/thermodynamics
3.	https://che.iitm.ac.in
4.	https://www.worldscientific.com/worldscibooks

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical-Heat Power Engineering

HP 1102: Advanced Heat Transfer

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of the course student will be able to:

1.	Understand the basic concepts and principles of thermal process applications.
2.	Analyse and design the thermal related equipments.
3.	Develop simulation of thermal system using advanced software tools.
4.	Identify the techniques to enhance the heat transfer in particular thermal applications.
5.	Understand performance characteristics of boiling and condensation process
6.	Analyse different heat transfer equipment's used in industrial applications.

	Course Contents	Hours
Unit 1	**Review of Basics of Heat transfer**: Differential Equation of Heat conduction in Cartesian conduction Cylindrical & Spherical coordinates of isotropic and anisotropic materials, Thermal conductivity variation with temperature for Solid, Liquid and Gases **Extended Surfaces:** Steady state analysis and optimization-Radial fins of rectangular and hyperbolic profiles-Longitudinal fin of rectangular profile radiating to free space, recent advances in Fins, their material and Heat Transfer enhancement Technique.	**(06)**
Unit 2	**Multi Dimensions steady state conduction**: Introduction, Mathematical analysis of two-dimensional Heat Conduction, Graphical Analysis, The conduction shape – factor, Numerical method of analysis, Gauss-Seidel Iteration, Electrical analogy for two –dimensional conduction	**(06)**
Unit 3	**Unsteady state conduction**: Introduction, Lumped Heat Capacity system, Transient heat flow in a semi-finite solid, Convection Boundary Conditions, Multi-dimensional system Transient numerical method, Thermal resistance and capacity formulation, Graphical Analysis – The Schmidt plot, Micro scale heat transfer	**(06)**
Unit 4	**Convection:** Laminar Boundary Layer on a flat plate energy equation of the Boundary layer, The thermal Boundary layer, The relation between Fluid friction and Heat transfer, Turbulent Boundary – Layer Heat transfer thickness, Heat transfer in laminar tube flow, Turbulent flow in a tube. Analogy for Laminar and Turbulent Flow, Empirical relations for pipe and tube flow, Flow across cylinders, spheres, Tube banks. Liquid metal heat transfer, Electronic Cooling, Transpiration Cooling and Abrasion Heat Transfer **Natural Convection:** Free convection Heat transfer on a vertical flat plate, Empirical relations and flow field for free convection, free convection from vertical planes and cylinders, Horizontal plates and cylinders, inclined surface.	**(07)**
Unit 5	**Radiation:** Radiation mechanism, properties, Shape factor, Shields, Radiation heat exchange between non-black bodies. Radiation network for an absorbing and Transmitting, Reflecting and absorbing media. Formulation for numerical solution, Thermal Radiations from a Luminous Fuel, Oil, gas and Flames, Radiation of Gases	**(07)**
Unit 6	**Condensation and Boiling:** Introduction, condensation heat transfer phenomena, the condensation number, Film condensation on inclined plates, vertical and horizontal tubes, sphere, tube banks. Condensation and Boiling enhancement Technique, Boiling Heat Transfer, Bubble dynamics and their heat transfer correlations for pool and flow boiling, Heat Pipes and their types.	**(07)**

Tutorials:-

Text Books

1.	**Saddik Kakac**: Heat Conduction, McGraw-Hill Pub.
2.	**S. P. Sukhatme:** Heat Transfer, Universities press.
3.	**J.P. Holman,** Heat Transfer, McGraw-Hill Pub.
4.	**A.J. Chapman:** Heat Transfer, Macmillan Publishing Co. New York 5

Reference Books

1.	**W.M. Kays and Crawford:** Convective Heat and Mass transfer, McGraw-Hill Co
2.	**Eckert and Drake:** Analysis of Heat Transfer, McGraw-Hill Co

3.	**Naylor:** Introduction to Convective Heat Transfer Analysis
4.	**Burmister**: Convective Heat Transfer
5.	**P.K. Nag:** Heat Transfer, TATA McGraw-Hill Co.
6.	**Incropera:** Fundamentals of Heat and Mass Transfer, 6 **Cengel:** Heat Transfer Practical Approach, McGraw Hills Co.
7.	**Bejan:** Convective Heat and Mass transfer

Useful Links			
1.	http://www.sciencedirect.com/science/bookseries		
2.	http://www.thermalfluidscentral.org/e-books		
3.	http://www.elsevier.com/books/advances-in-heat-transfer		
4.	http://www.ecs.umass.edu/mie/faculty/rothstein/mie606_fall02.pdf		

Government College of Engineering, Karad

First Year (Sem– I) M. Tech. Mechanical-Heat Power Engineering

ME 1113: Nuclear Engineering (Elective-I)

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of the course students will be able to:

1.	Understand the energy exchange processes due to Heat transfer that are relevant to nuclear energy systems.
2.	Select materials for nuclear reactor applications
3.	Know working principle of fission and fusion reactors
4.	Understand the nuclear reactor applications
5.	Carry future research in the field of nuclear engineering
6.	Understand concepts applicable to controlled thermonuclear fusion and its application in the field of power production.

	Course Contents	Hours
Unit 1	**Nuclear Material**: Structure of a power plant, Requirements of reactor materials-fuel materials-plutonium, uranium and thorium and their alloys and compound core materials-beryllium, graphite control and shielding materials- magnesium and its alloys, aluminium and its alloys, Coolant used in reactors, radiation embrittlement- corrosion, reactor materials-Mechanical properties of materials.	**(08)**
Unit 2	**Fission Reactors:** Radiation, Fission, reactor and reactor elements, characteristics of fission materials-Density – Melting point-Electrical and thermal conductivity, Fission cross section. Coolants, Cladding materials, Moderator, Heat exchanger, Arrestor. **Fusion Reactors**: Lawson criteria, heating of plasma, confinement of plasma in magnetic mirror and tokamak, basic concepts of plasma instabilities, generation of nuclear power and future challenges	**(08)**
Unit 3	**Application of Radioisotopes:** Nuclear systematics - naturally occurring radioactive isotopes and series , instrumental techniques for detection and measurement of radioactivity, radioactive methods for prospecting and assaying of mineral (radioactive and non-radioactive) deposits, applications of radioactivity and radon in prospecting for oil and hydrocarbon deposits, applications of radiometric studies to paleoseismology, Radioisotopes and applications in industry and medicine	**(08)**
Unit 4	**Radiation Applications:** Radiotracing principle and techniques- Radiotraces applications to engineering processes-Radiogauging principles, techniques and applications- Radiation shielding-Environmental transport of radionuclides	**(08)**
Unit 5	**Nuclear Reactor & Applications:** Thermal Parameter-sources and distribution of thermal loads in nuclear Power reactor, Conservation equation and their applications to nuclear power systems, Nuclear waste management.	**(06)**
Unit 6	**Nuclear Hydraulics:** Thermal Hydraulics: convective and/or boiling heat transfer at fuel element surface, conductive heat transfer inside elements, pressure drops, heat exchanger calculations, thermodynamic cycle efficiency, steam turbine reheat and regeneration, preheating and inlet sub-cooling	**(07)**

Tutorials:--

Text Books

1.	**Kopelmen:** Materials for nuclear reactors, McGraw-Hill Publication, 1970
2.	**Richard T. Lahey and Frederick J. Moody:** The Thermal-Hydraulics of Boiling Water Reactors, 2nd Edition, American Nuclear Society (1993)
3.	**S. Glasstone and A. Sesonske:** Nuclear Reactor Engineering, D. Van Nostrand Company, INC. 1967
4.	**G.F. Knoll:** Radiation detection and measurement, John Wiley &Sons, 3ed, London, 2000

Reference Books

1.	**Kenneth Joy:** Nuclear Power-Today and Tomorrow, Methven, 1961
2.	**J.J. Duderstadt and L.J. Hamilton:** Nuclear Reactor Analysis, John Wiley,1976
3.	**RE. Fand J.K. Shultis:** Radiological Assessment, Prentice Hall, 1993.
4.	**K, Heyde:** Basic Ideas and Concepts in Nuclear Physics, Overseas Press, Second Edition, New Delhi, 1998

Useful Links

1.	https://www.iaea.org/topics/nuclear-science/isotopes/stable-isotopes

2.	https://www.sciencedirect.com/journal/nuclear-engineering-and-design
3.	https://www.sciencedirect.com/journal/nuclear-engineering-and-technology/vol/51/issue/3
4.	https://nptel.ac.in/downloads/112101007/
5.	https://nptel.ac.in/syllabus/112101007/ (**Prof. Kannan.N.Iyer** IIT bombay)

Note: Equivalent online course of NPTEL, IIT Bombay Course coordinator Prof. Kannan Iyer may be registered

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First Year (Sem – I) M. Tech. Mechanical-Heat Power Engineering

HP 1123: Energy Conservation & Management (Elective-I)

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of the course:

1.	Student will be able to acquire insight about the importance of energy
2.	Student will be able to analyze all scenarios from energy consumption
3.	Student will be able to understand scenarios of energy consumption and predict the future trend
4.	Student will be able to create and plan energy conservation solutions
5.	Student should familiar of energy management of engineering systems.
6.	Students will interpret the importance and principles of energy conservation.

	Course Contents	Hours
Unit 1	**Introduction:** The energy market, energy scenario, planning, utilization pattern and future strategy, Importance of energy management.	**(07)**
Unit 2	**Energy auditing:** methodology and analysis: Introduction, Types, Preliminary audit, and Intermediate and Comprehensive audit, Procedure of auditing, Case studies and Recommendations.	**(07)**
Unit 3	**Energy economics**: Initial & annual costs, Definitions of annual solar savings, Life cycle savings, Present worth calculations, Repayment of loan in equal Annual instalments, Annual solar savings, Cumulative Solar Savings and life cycle Savings, Pay-back period	**(07)**
Unit 4	**Energy conservation:** Energy conservation in industries, Cogeneration, Combined heating and power systems: Importance, Principles, Planning for Energy Conservation-Electrical energy, Thermal energy, Human & animal muscle energy. Waste Recovery /Recycling, Cogeneration.	**(07)**
Unit 5	**Energy Management:** Energy Strategic Planning, Management of supply side, Elements, steps, flow. Management of Utilization side-Elements, transmission, Equipment and control systems, principles of Energy Management	**(08)**
Unit 6	**International Standards and Laws:** Relevant international standards and laws.	**(04)**

Tutorial:-

Text Books

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

Reference Books

1.	TERI Publications.
2.	Callaghan "Energy Conservation".

Useful Links

1.	http://www.energy.gov/eere/buildings/analysis-tools
2.	http://www.sciencedirect.com/science/article/pii/S0306261907000153
3.	https://www.aspentech.com/Products/Activated-Energy-Analysis
4.	http://www.nptel.ac.in/courses/108106022

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical-Heat Power Engineering

HP 1133: Design of Fluid Power System (Elective-I)

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of the course:

1.	Student will understand the basic laws, principle, operation and applications of fluid power systems.
2.	Student will select the proper hydraulic or pneumatic component for a specific fluid power application.
3.	Students will interpret any hydraulic and pneumatic application circuits with practice of symbols and ISO/JIC standards.
4.	Students will develop and design basic fluid power and control circuit related to industrial applications.
5.	Students will analyze the system behavior for various types of inputs and carry out the dynamic analysis of fluid power systems.
6.	Students will acquire the collected information that will assist in the solution of many problems encountered in the application of fluid power in the industry.

	Course Contents	**Hours**
Unit 1	**Distribution of Fluid Power** – Choice of distribution, conductor sizing, burst pressure and working pressure, steel pipes, tubing, flexible hoses, Energy losses in hydraulic system – Frictional losses in laminar and turbulent flow, valve and fittings, equivalent length techniques	**(05)**
Unit 2	**Hydraulic System Elements-** a) Pumps-types-Gear, lobe, screw, vane, piston, selection of pumps, theoretical flow rate, pump performance – efficiencies b) Hydraulic Cylinders- Types, single acting, double acting, telescopic and tandem, cylinder force, velocity and power, acceleration and deceleration of cylinder loads, load calculations for vertical, horizontal and inclined cylinders, first, second and third –class lever systems c) Hydraulic Motors-Types, gear, vane and piston, semi-rotary actuators, analysis of a semi-rotary single-vane motor, performance of hydraulic motors- efficiencies	**(10)**
Unit 3	**Fluid Power Systems Accessories-** **Hydraulic Systems** - Classification, reservoirs-types and sizing, Accumulators- types, selection, sizing accumulators, applications, fluid conditioners, filters and strainers, heat exchangers, hydraulic lines-sizing, burst and working pressure **Pneumatic Systems** - Compressors- Types, piston, screw and vane, air capacity rating of compressors, power required to drive compressors, sizing of air receivers, Fluid conditioners- air filters, air pressure regulators, air lubricators, FRL unit, air dryers	**(06)**
Unit 4	**Flow and Force Analysis of Valves-** Mathematical analysis of hydraulic valves - four way spool valve, three way spool valve, flapper nozzle valve, special purpose valve, pressure compensated flow control valve.	**(06)**
Unit 5	**Fluid Power Circuit Design and Analysis –** A) Design of hydraulic system for industrial applications includes following 1. Load, Pressure and flow calculations 2. Sizing and selection of components 3. Design constraints considerations 4. Circuit preparation 5. Energy losses in systems B) Pneumatic control circuit – control of rod less cylinder, speed control of double acting cylinder, pneumatic logic control, structure of pneumatic, timing diagram, cyclic operation of cylinder.	**(07)**
Unit 6	**Dynamic analysis of fluid systems-** First order – Fluid system, electrical system, Fluid hydraulic servo mechanism, Graphical representation, Harmonic response locus, logarithmic plots.	**(06)**

Tutorials- -

Text Books

1.	Oil hydraulics Systems", S. R. Mujumdar, Tata McGraw Hill Publication, 1st Edition, 2005
2.	Pneumatic Systems", S. R. Mujumdar, Tata McGraw Hill Publication, 1st Edition, 2005

3.	“Fluid Power with Applications”, Anthony Esposito, Prentice-Hall India Publication, 6th Edition
4.	“Pneumatic Controls”, Joji P., Wiley India , 1st Edition, 2009
5.	“Fluid Power”, Jagadeesha T., Wiley Publications, 1st Edition, 2013
Reference Books	
1.	Hydraulic and Pneumatic”, H. L. Stewart, Industrial Press
2.	Industrial Hydraulic”, J. J. Pipenger, Tata McGraw Hill
3.	“Introduction to Hydraulic and Pneumatics”, S. Ilango and V. Soundararajan, Prentice Hall of India, 2nd Edition
4.	Hydraulics and Pneumatics Workshops User’s Guide”, Automation Studio 5.7, Latest Edition, 2013
Useful Links	
1.	https://www.fluidpowerworld.com
2.	https://www.hydraulicspneumatics.com
3.	https://appliedfluidpower.com
4.	https://www.fpsindia.net/

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First Year (Sem – I) M. Tech. Mechanical-Heat Power Engineering

HP1114: Air Conditioning System Design (Elective-II)

Teaching Scheme			Examination Scheme	
Lectures	03Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of the course:

1.	Student should understand construction and design features Air-conditioning system.
2.	Student should understand various types and its adoptability in the various environment and application areas.
3.	Student should understand various health issues and comfort conditions.
4.	Student should design seasonal energy efficient system.
5.	Student should understand and able to select air distribution system.
6.	Student should understand various air conditioning equipment and their selection.

	Course Contents	Hours
Unit 1	**Requirement of comfort air conditioning** - Factors affecting human comfort, comfort chart, Psychrometric properties of moist air, Psychrometric processes, Application & Safety in various industries like, Pharma, Electronic, Paper, Paint, Metallurgy, Foundry, Hospitals, Hotel & Recreation, Automobile, Rail-Road, food& Aircraft.	**(07)**
Unit 2	**Air conditioning systems** – Summer air conditioning, Winter air conditioning, year round air conditioning, Central air conditioning system, Unitary air conditioning system, All water system, All-air Air conditioning system, Variable air volume system.	**(06)**
Unit 3	**Cooling Load calculations and Design of air conditioning system** - Different heat sources, conduction heat load, radiation load of Sun, Occupants load, equipment load, Infiltration air load, miscellaneous heat sources, fresh air load, Design of air condition system, cooling coils and dehumidifying air washers.	**(08)**
Unit 4	**Air Distribution**- Fundamentals of air flow in ducts, pressure drop calculations, design ducts by velocity reduction method, equal friction method and static regain method, duct materials and properties, insulating materials, types of grills, diffusers, wall registers **Ventilation and Infiltration**: Requirement of ventilation air, various sources of Infiltration air, ventilation and infiltration as a part of cooling load.	**(07)**
Unit 5	**Acoustics & Noise Control** –Definitions of various terms like level, pitch, attenuation, frequency, sources of noise in air conditioning plants, design procedure for noise prevention, noise and vibration study and elimination techniques (description only). **Odor and bacteria –** Air filtration- Study of different types of filters, BMS applications, Clean Air Practices	**(06)**
Unit 6	**Air conditioning equipments and Equipment Selection –** Performance& selection of compressors, fans, blowers, Pumps & cooling towers, Pre cooling, Chillers, Condensing units, Cooling coils, bypass factors, humidifiers, dehumidifiers, various types of filters, air washers, Thermostat, humidistat.	**(06)**

Tutorials : --

Text Books :

1.	Refrigeration and Air conditioning by Arora and S. Domkundwar
2.	Refrigeration and Air conditioning by C P Arora
3.	Refrigeration and Air conditioning by Dr. S. S. Thipse

Reference Books

1.	ASHRAE Handbooks
2.	ISHRAE Handbook.
3.	Handbook of Air Conditioning System Design, Carrier Incorporation, McGraw Hill Book Co., USA.
4.	Trane air conditioning manual
5.	Refrigeration & Air-Conditioning by Dr. S. N. Sapli- PHI Publication

Useful Links	
1.	http://www.sciencedirect.com/science/book/9781933742137
2.	http://www.iaeng.org/publication/IMECS2009/IMECS2009_pp1828-1833.pdf
3.	http://www.nptel.ac.in/courses/112105129/pdf/R&AC%20Lecture%2038.pdf

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical-Heat Power Engineering

HP1124: Gas Turbines (Elective-II)

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of the course student will able to:

1.	Understand construction and design features of gas turbines as used for power generation.
2.	Understand thermodynamics cycles a, and different sizes and layouts of gas turbine plant
3.	Understand thermodynamics and fluid mechanics component for enhancing the efficiency and effectivity of gas turbines
4.	Understand Jet propulsion cycles and their analysis
5.	Understand various fuels and fuel systems.
6.	Understand materials For Gas Turbine: Factors influencing selection of materials.

	Course Contents	Hours
Unit 1	**Introduction:** Historical development, comparison with reciprocating I.C. Engines. Applications of gas turbine power plants. Thermodynamics Cycles for Gas Turbines: Air standard Brayton cycle, Calculation of the thermal efficiency, cycle air rate, cycle work-ratio, and optimum pressure ratio for maximum work output of the cycle. Simple open cycle gas turbine. Modification of gas turbine cycle with inter-cooling, reheating and regeneration and effect on thermal efficiency and specific output. Closed cycle gas turbine and semi-closed cycle gas turbine. Their comparison with open cycle, Co generative power plant (Numerical problems to be taught)	**(06)**
Unit 2	**Compressors:** Types commonly used for gas turbine power plants. (Numerical problems to be taught) A. Centrifugal Compressors: Principal of operation, work done and pressure rise. Vane-less pace, slip factor, power input factor and Mach number at intake to impeller. B. Axial Flow Compressors: Working principal, work done degree of reaction, poly-tropic efficiency, overall performance of the compressors	**(06)**
Unit 3	**Fuels and Combustion:** Chambers Requirement of combustion chamber, combustion process, pressure loss and pressure loss factor. Combustion chamber geometry and types. Solid, liquid and gaseous fuels used for gas turbine power plants. Fuel burning arrangements and ignition	**(06)**
Unit 4	**Turbines:** Impulse and reaction turbines, turbine efficiencies, nozzle efficiency, blade efficiency, mechanical and overall efficiency. Theory of impulse and reaction turbines, number of stages and limitations. Constructional details of shafts, bearings, blades and casings. Cooling of blades, Lubrication and governing of turbines. Maintenance and troubleshooting (Numerical problems to be taught)	**(06)**
Unit 5	**Materials For Gas Turbine:** Factors influencing selection of materials, materials used for different component like compressor component, combustion chamber, disc and rotors, turbine blades, nozzle guide vanes turbine casing and heat exchanges	**(07)**
Unit 6	**Jet Propulsion And Rocket Propulsion:** Theory of jet propulsion features and types of different jet engines performance efficiencies and applications, Types of rocket power plants and their application(Numerical problems to be taught)	**(07)**

Tutorials:--

Text Books

1.	H Cohen, GFC Rogers and HIH Saravana muttoo, “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.

Reference Books

1.	Vincent “The Theory And Design Of Gas Turbines And Jet Propulsion” McGraw-Hill Publication
2.	W.W. Battic “Fundamentals of Gas Turbines” John Wily& Sons
3.	JackD. Mattingly “Elements of Gas Turbines And Propulsion” McGraw-Hill Publication.

Useful Links			
1.	https://nptel.ac.in/courses/112104117/13		
2.	https://nptel.ac.in/courses/112104117/4		
3.	https://nptel.ac.in/courses/112106166/28		

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical-Heat Power Engineering

HP1134: Advanced Automobile Engineering (Elective-II)

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of the course:

1.	Student will able to familiarize with latest developments in Automobile Engineering industries
2.	Student will aware of current development in electrical and hybrid vehicles
3.	Student will identify the use of controls and automation in Advanced Automobile Engineering
4.	Student will get appropriate knowledge in computerization of various components in vehicle systems
5.	Student will identify the use of pollution control and fuel economy components.
6.	Student will able to understand various braking systems.

	Course Contents	Hours
Unit 1	**The Future of The Automotive Industry:** Challenges and Concepts for the 21st century. Crucial issues facing the industry and approaches to meet these challenges. Fuel Cell Technology For Vehicles: What is fuel cell, Type of fuel cell, Advantages of fuel cell.	**(07)**
Unit 2	**Current state of the technology:** Potential and challenges. Advantages and Disadvantages of hydrogen fuel. Hybrid vehicles-Stratified charged/learn burn engines-Hydrogen engines-battery vehicles–Electric propulsion with cables–Magnetic track vehicle.	**(07)**
Unit 3	**Volt System:** Need, benefits, potentials and challenges, Technology Implications for the Automotive Power system; power steering, power brakes, windows, Automated systems; computer controlled front collision prevention, navigation, GPS etc. Computer Control for pollution and noise control and for fuel economy-Transducers and actuators-Information technology for receiving proper information and operation of the vehicle like optimum speed and direction.	**(08)**
Unit 4	**Electrical and Hybrid Vehicles:** Types of hybrid systems, Objective and Advantages of hybrid systems. Current status, Future developments and Prospects of Hybrid Vehicles Integrated Starter Alternator: Starts stop operation, Power Assist, Regenerative Braking. Advanced lead acid batteries, Alkaline batteries, Lithium batteries. Development of new energy storage systems. Deep discharge and rapid charging ultra-capacitors.	**(08)**
Unit 5	**X-By Wire Technology:** Introduction to X-By Wire, Advantage over hydraulic systems, Use of Automotive micro controllers, Types of censors, Use of actuators in an automobile environment.	**(06)**
Unit 6	**Vehicles Systems:** Constantly Variable Transmission, Benefits, Brake by wire, Advantages over power Braking System, Electrical assist steering, Steering by wire, Advantages of Steering by wire, Semi-active and fully-active suspension system, Advantages of fully active suspension system.	**(06)**

Text Books

1.	Heinz Heisler, “Advanced Vehicle Technologies”, SAE International Publication
2.	Ronald K. Jurgen, “Electric and Hybrid Electric Vehicles”, SAE InternationalPublication
3.	Daniel J. Holt, “42 Volt system”, SAE International Publication
4.	Electronic Braking, Traction and Stability control-SAE Hardbound papers

Reference Books

1.	Electronics steering and suspension systems-SAE Hardbound papers
2.	J.H. Johnson, “Diesel Paniculate Emission”, SAE Hardbound papers
3.	Richard Stobart, “Fuel Cell Technologies for vehicles”, SAE Hardbound papers

Useful Links

1.	http://www.vssut.ac.in/lecture_notes/lecture1428910741.pdf
2.	http://www.vssut.ac.in/lecture_notes/lecture1428910741.pdf

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical- Heat Power Engineering

RM1105: Research Methodology

Teaching Scheme			Examination Scheme	
Lectures	02 Hrs/week		CT – 1	15
Tutorials			CT – 2	15
Total Credits	02		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of course student will able to:

1.	Understand research problem formulation.
2.	Analyze research related information
3.	Follow research ethics
4.	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5.	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6.	Understand 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.

	Course Contents	Hours
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	**(5)**
Unit 2	Effective literature studies approaches, analysis, Plagiarism, Research ethics,	**(3)**
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	**(4)**
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.	**(5)**
Unit 5	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	**(4)**
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.	**(4)**

Tutorials:--

Text 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, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4.	Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

Reference Books

1.	Mayall , "Industrial Design", McGraw Hill, 1992.
2.	Niebel , "Product Design", McGraw Hill, 1974.
3.	Asimov , "Introduction to Design", Prentice Hall, 1962.
4.	Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
5.	T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Useful Links

1.	https://www.explorable.com/research-methodology
2.	http://www.socscidiss.bham.ac.uk/methodologies.html

3.	http://www.humanities.manchester.ac.uk/studyskills/methodology.html

Government College of Engineering, Karad				
First Year (Sem – I) M. Tech. Mechanical- Heat Power Engineering				
HP 1106: Lab Practice I				
Teaching Scheme			**Examination Scheme**	
Practicals	04 Hrs/week		CA	25
Total Credits	02		ESE	25

Course Outcomes (CO)	
1.	Students will acquire hands on experience on the various test-rigs, Experimental set up.
2.	Students should able to measure the various technical parameters by instrument and by mathematical relationship.
3.	Students will able to identify the effect of various parameters on the system and able to co- relate them.
Experiments	
1.	To measure effect of various liquids on unsteady conduction process.
2.	To measure natural convective heat transfer coefficient and its correlations with horizontal, tilted and vertical position of object.
3.	To understand effect of emissivity and colours of objects on radiation
4.	Combustion analysis in closed and open systems such as boiler furnace, gas turbine combustors, Rocket motors, IC engine, etc.
5.	Analysis of errors in thermal measurement systems
6.	Experimental Dynamic response characterization of first order/second order instruments
7.	Design of heat exchanger- numerical solution
8.	Determination of heat transfer coefficient during boiling / condensation.

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical- Heat Power Engineering

HP 1107: Lab Practice II

Teaching Scheme		Examination Scheme	
Practicals	04 Hrs/week	CA	25
Total Credits	02	ESE	25

Lab Outcomes (LO)

1.	Students will acquire hands on experience on the various softwares used in thermal industrial applications
2.	Students should able to analyse the various technical parameters in thermal applications by mathematical relationship.
3.	Students will able to identify the effect of various parameters on the system and able to co- relate them using MATLAB and Simulink

Experiments:

Total 8 Experiments on following Core/Elective-I & II courses using MATLAB & Simulink software

1) Thermodynamics and Combustion
2) Advanced Heat Transfer
3) Elective-I
4) Elective-II

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical-Heat Power Engineering

OE1138: Operations Research

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of the course, the students will able to

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

	Course Contents	Hours
Unit 1	Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models	**(06)**
Unit 2	Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming	**(07)**
Unit 3	Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT	**(06)**
Unit 4	Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	**(06)**
Unit 5	Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	**(07)**

Text Books

1.	J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008
2.	Hitler Libermann Operations Research: McGraw Hill Pub. 2009
3.	Pannerselvam, Operations Research: Prentice Hall of India 2010

Reference Books

1.	H.A. Taha, Operations Research, An Introduction, PHI, 2008
2.	H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3.	Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical-Production Engineering

AU1119: Research Paper Writing (Audit Course – 1)

Teaching Scheme			Examination Scheme	
Lectures	02 Hrs/week		CT – 1	--
Tutorials	-		CT – 2	--
Total Credits	00		TA	--
			ESE	--
			Duration of ESE	--

Course Outcomes (CO)

At the end of the course students will able to:

1.	Understand that how to improve your writing skills and level of readability.
2.	Learn about what to write in each section.
3.	Understand the skills needed when writing a Title

	Course Contents	Hours
Unit 1	Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	**(04)**
Unit 2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	**(04)**
Unit 3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	**(04)**
Unit 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,	**(04)**
Unit 5	Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	**(04)**
Unit 6	Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	**(04)**

Text Books

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

Reference Books

1.	Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
2.	Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical- Production Engineering

AU1129: Disaster Management (Audit Course – I)

Teaching Scheme			Examination Scheme	
Lectures	02 Hrs/week		CT – 1	--
Tutorials	-		CT – 2	--
Total Credits	00		TA	--
			ESE	--
			Duration of ESE	--

Course Outcomes (CO)

At the end of the course, the students will:

1.	learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response
2.	critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives
3.	develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

	Course Contents	Hours
Unit 1	**Introduction** Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.	**(04)**
Unit 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.	**(04)**
Unit 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	**(04)**
Unit 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.	**(04)**
Unit 5	**Risk Assessment** Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques af Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival	**(04)**
Unit 6	**Disaster Mitigation** Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Disaster Mitigation in India.	**(04)**

Tutorials- --

Text Books

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

Government College of Engineering, Karad

First Year (Sem-II) M. Tech Mechanical- Heat Power Engineering

HP1201: Advanced Fluid Dynamics

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	Students will familiarize with properties of fluids and their influence on the operation of various fluid flow applications
2.	Students will analyze governing equestrians, pressure variation and pressure loss due to friction in flowing fluid
3.	Students will identify forces due to flow of fluids over bodies using boundary layer theory
4.	To provide a technical understanding of use of computer and advanced tools related with Advanced Fluid Mechanics
5.	Students will develop skill to analyze various fluid flows using latest fluid simulation techniques
6.	Student will able to carry future research in the field of fluid dynamics

	Course Contents	Hours
Unit 1	**Concept of Continuum & Fluid:** Body and Surface Forces, Scalar and Vector fields, Eulerian and Lagrangian description of flow, Motion of Fluid element- Translation, Rotation& Velocity **Governing Equations:** Mass conservation in differential and integral forms, Flow kinematics, and Momentum equation: substantial derivative, differential and integral Form, stress tensor, stress strain relations, Ideal Fluid flow concepts	**(07)**
Unit 2	**Mechanics of Laminar Flow**: Introduction Laminar and Turbulent flows, Viscous flow at different Reynolds number-wake frequency, Laminar plane Poiseuille flow, stokes flow, Flow through Concentric annulus, Laminar Flow in Pipes and Channels	**(07)**
Unit 3	**Navier-Stokes Equations:** Special forms: Euler equations, Bernoulli equation, stream function, vorticity. Exact solutions: fully developed flow in channel, pipe, flow between concentric rotating cylinders, Couette flow, Stokes First problem (unsteady flow), Creeping	**(08)**
Unit 4	**Boundary Layers:** Boundary layer assumptions, equations, flow over a flat plate similarity (Blasius) solution, Falkner-Skan equation, momentum integral method external lows: drag, lift, flow separation	**(06)**
Unit 5	**Turbulent flow:** Introduction to hydrodynamic stability, characteristics of turbulence governing equations, turbulent boundary layer, algebraic models (Prandtl's mixing length), and velocity profile over a flat plate and in pipes **Turbulent Shear Flows:** Equations for free shear layers: mixing layer, plane and axis symmetric jet, wake. Turbulent energy equation, two equation model(k-epsilon), Large Eddy Simulation, Various Turbulent Models	**(07)**
Unit 6	**Compressible Flow**: One-dimensional Flow: speed of sound, variable cross- section flow, converging diverging nozzle, effect of friction and heat transfer, normal shock relations, Introduction to oblique shocks, 2-dimensional flows (subsonic and supersonic) past slender bodies, compressible boundary layers	**(07)**

Tutorials:--

Text Books

1.	**Mohanty A.K.:** Fluid Mechanics, II edition, PHI private Ltd. New Delhi
2.	**E. Radhakrishnan**: Fluid Mechanics, II edition, PHI private Ltd. New Delhi
3.	**James A. Fay**: Introduction to Fluid Mechanics, PHI private Ltd. New Delhi
4.	**Streeter**: Fluid Mechanics, Tata McGraw Hill, New Delhi

Reference Books

1.	**Schlichting:** Boundary layer theory, Springer Pub
2.	**G. Biswas and K. Muralidhar:** Advanced Fluid mechanics, Alpha Science International Ltd. Publisher
3.	**Fox R.W. and McDonald A.T:** Introduction to Fluid Mechanics John Wiley & Sons
4.	**Bird R.B. Stewart W.F**.: "Transport Phenomena", John Wiley & Sons

Useful Links

1.	https://ocw.mit.edu/courses/mechanical-engineering/2-25-advanced-fluid-mechanics-fall-2013/
2.	https://www.elsevier.com/books/advanced-fluid-mechanics/graebel/978-0-12-370885-4

3.	https://www.sciencedirect.com/book/9780884154976/advances-in-engineering-fluid-mechanics-multiphase-reactor-and-polymerization-system-hydrodynamics
4.	https://nptel.ac.in/courses/112105218/
5.	https://nptel.ac.in/syllabus/syllabus_pdf/112106184.pdf
6.	https://nptel.ac.in/syllabus/112106185/

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical-Heat Power Engineering

HP1202: Steam Engineering

Teaching Scheme			Examination Scheme	
Lectures	03Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of the course:

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

	Course Contents	Hours
Unit 1	**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.	**(07)**
Unit 2	**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.	**(07)**
Unit 3	**Steam Systems -** Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash team recovery system, Steam Engineering Practices; Steam Based Equipments /Systems.	**(07)**
Unit 4	**Boiler Performance Assessment -** Performance Test codes and procedure, Boiler Efficiency, Analysis of losses; performance evaluation of accessories; factors affecting boiler performance.	**(08)**
Unit 5	**Energy Conservation and Waste Minimization-** Energy conservation options in Boiler; waste minimization, methodology; economical viability of waste minimization.	**(05)**
Unit 6	**Instrumentation & Control -** Process instrumentation; control and monitoring. Flow, pressure and temperature measuring and controlling instruments, its selection.	**(06)**

Text Books

1.	Domkundwar; A Course in Power Plant Engineering; Dhanapat Rai and Sons
2.	Yunus A. Cengel and Boles, "Engineering Thermodynamics ",Tata McGraw-Hill Publishing Co.Ltd
3.	Power plant Technology M.M.EI-Wakil McGRAW- HILL.

Reference Books

1.	Edited by J. B. Kitto & S C Stultz; Steam: Its Generation and Use; The Babcock and Wilcox Company
2.	Book II - Energy Efficiency in Thermal Utilities; Bureau of Energy Efficiency
3.	T. D. Estop, A. McConkey, Applied Thermodynamics, Parson Publication.

Useful Links

1.	http://www.speboilers.com/
2.	http://www.cmcmarine.in/marine_boiler_steam_engineering_op.php
3.	http://go2engineering.com/html/career_oppourtunities_MISC_steamengg.asp

Government College of Engineering, Karad

First Year M. Tech. (Sem-II) Mechanical- Heat Power Engineering

HP1213: Refrigeration and Cryogenics (Elective-III)

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of course student will be able to **:**

1.	Understand the basics of refrigeration and cryogenics
2.	Know the developments in refrigeration and cryogenics
3.	Learn about ODP, GWP and related environment issues.
4.	Analyze various refrigeration systems for thermal performance.
5.	Evaluate the performance of various refrigeration systems.
6.	Design the refrigeration systems for domestic and industrial applications

	Course Contents	Hours
Unit 1	**Recapitulation of Fundamentals:** fundamental methods of refrigeration, Vapour compression refrigeration cycle, Representation on P-h, T-s diagram, actual VCR cycle, second law efficiency and COP.	**(05)**
Unit 2	**Multistage Systems and Analysis:** Multistage compression with inter-cooling, Multi-evaporator systems, Cascade systems, Concept of Heat Pump.	**(06)**
Unit 3	**Refrigeration Equipment's:** Performance characteristics and capacity control of reciprocating and centrifugal compressors, screw compressor and scroll compressor, Design, selection of evaporators, condensers, control systems, motor selection.	**(07)**
Unit 4	**Refrigerants:** Refrigerants & their nomenclature, types and properties. Primary & Secondary refrigerants, Alternative eco-friendly refrigerants and their properties, Refrigerant-lubricant mixture behaviour, Blending of refrigerants, ODP, GWP concepts, CFC/HCFC phase-out regulations, Montreal and Kyoto Protocols.	**(05)**
Unit 5	**Vapour Absorption Systems and Analysis:** Binary mixtures, Construction of Enthalpy-Concentration Charts, Basic processes of binary mixtures, Standard cycle and actual cycle, thermodynamic analysis, Li-Br-water, NH3-water systems, Three fluid absorption systems, single effect and double effect systems. **Refrigeration applications:** Industrial Refrigeration, Chemical and process industries, Dairy plants, Petroleum refineries, Food preservation, Transport, etc.	**(09)**
Unit 6	**Cryogenics:** Historical Background and development, present state of affairs of cryogenic engineering. Gas liquefaction systems - Linde-Hampson, Linde dual pressure, Claude cycle, Cryogenic fluid storage. Various fields of application such as Superconducting devices, Space technology, Mechanical Design, Food preservation and Medicine.	**(08)**

Tutorials:----------

Text Books

1.	**R.J. Dossat:** Principles of Refrigeration, Pearson Education Asia, 2001
2.	**C. P. Arora:** Refrigeration & Air-Conditioning, Tata McGraw Hill, Third Edition, 2004.
3.	**Manohar Prasad:** Refrigeration & Air-Conditioning, New Age Intl. Publications, Third edition, 2010
4.	**R. Barron:** Cryogenic systems, McGraw–Hill Company, New York, 1985.

Reference Books

1.	**Stoecker & Jones:** Refrigeration and Air-conditioning, McGraw Hill Book Company, New York, 1982.
2.	**Jordan & Priester:** Refrigeration & Air Conditioning, Prentice-Hall India, Second edition, 1973.
3.	**W.F.Stoecker:** Industrial Refrigeration Handbook, McGraw-Hill, 1998.
4.	**A.R.Trott:** Refrigeration and Air-conditioning", Butterworths, 2000.
5.	**P.C.Koelet:** Industrial Refrigeration: Principles, Design and Applications, Macmillan, 1992.
6.	**ASHRAE HANDBOOKS** (i) Fundamentals (ii) Refrigeration
7.	**Graham Walker:** Miniature Refrigerators for Cryogenic Sensors and Cold Electronics, Clarendon Press, 1989

Useful Links

1.	http://nptel.ac.in/courses/112105128/
2.	http://nptel.ac.in/downloads/112105129/
3.	http://nptel.ac.in/courses/112107208/
4.	http://www.emersonclimate.com/en-US/Brands/Vilter/Pages/brochure.aspx
5.	https://www.beestarlabel.com/

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical-Heat Power Engineering

HP 1223: Design of Heat Exchangers (Elective-III)

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of course student will be able to **:**

1.	Student will able to design of Heat Exchanger used in process industries
2.	Student will able to understand the various design aspects Heat Exchangers
3.	Student will able to design HeX used in process industries
4.	Student will able to design different heat recovery equipments used in industrial applications
5.	Student will understand performance characteristics of different Cooling Tower.
6.	Student will able to analyse different heat transfer equipment's used in industrial applications.

	Course Contents	Hours
Unit 1	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.	**(06)**
Unit 2	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.	**(06)**
Unit 3	Double Pipe Heat Exchangers: Thermal and Hydraulic design of inner tube, Thermal and hydraulic analysis of Annulus, Total pressure drop	**(07)**
Unit 4	Compact Heat Exchangers: Thermal and Hydraulic design of compact heat exchanger	**(07)**
Unit 5	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	**(07)**
Unit 6	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.	**(07)**

Text 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.

Reference Books

1.	A .P. Frass and M.N. Ozisik, "Heat Exchanger Design", McGraw Hill, 1984
2.	T. Kuppan, "Hand Book of Heat Exchanger Design".
3.	"T.E.M.A. Standard", New York, 1999.
4.	G. Walkers, "Industrial Heat Exchangers-A Basic Guide", McGraw Hill, 1982
5.	Afgan N. and Schlinder E.V. "Heat Exchanger Design and Theory Source Book".

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical-Heat Power Engineering

HP 1233: Advanced Mathematical Methods in Engineering

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of course student will be able to

1.	Analyse and develop the mathematical model of thermal system.
2.	Analyse the reliability and maintainability of the series and parallel thermal system.
3.	Solve differential equations using numerical techniques.
4.	Apply the knowledge of advanced mathematical methods to solve engineering problems

	Course Contents	Hours
Unit 1	Ordinary Differential Equations: First-order equations (Linear, Equidimensional, Separable Exact, Homogeneous,); Second-order linear differential equations (homegeneous and nonhomogeneous); Solution methods such as undertermined coefficients and variation of parameters.	**(06)**
Unit 2	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	**(06)**
Unit 3	Standard discrete and continuous distributions like Binomial, Poisson, Normal, Exponential etc. Central Limit Theorem and its significance. Some sampling distributions like c2, t, F.	**(07)**
Unit 4	ANOVA: One – way, Two – way with/without interactions, Latin	**(07)**
Unit 5	Squares ANOVA technique, Principles of Design of Experiments, some standard designs such as CRD, RBD, LSD.	**(07)**
Unit 6	Some of the relevant topics required for ANOVA (sample estimates and test hypothesis) may also be included.	**(07)**

Text 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).

Reference Books

1.	Jennings. A., Matrix Computation for Engineers and Scientists. John Wiley and Sons, 1992.
2.	Prem.K.Kythe, Pratap Puri, Michael R.Schaferkotter, Introduction to Partial Differential Equations and Boundary Value problems with Mathematics, CRC Press, 2002.
3.	Kreyszig, Erwin, I.S., Advanced Engineering Mathematics, Wiley, 1999.
4.	Ramamurthy. V., Computer Aided Design in Mechanical Engineering., Tata McGraw Hill Publishing Co., 1987
5.	Fundamental Concepts in the Design of Experiments, 5th Ed., by Hicks and Turner Devore, Jay L., Probability and Statistics for Engineering and the Sciences, 5th edition, Brooks- Cole (1999)

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical-Heat Power Engineering

HP 1214: Computation Fluid Dynamics (Elective-IV)

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	Student will learn a new third approach to solve engineering problems related to heat transfer and fluid flow and to compare with experimental and analytical method
2.	Student will able do simulations of industrial problems related to thermal and fluid flow using advanced software tools
3.	Student will able to create base and interest for future research as learning this subject is like having new tool to students
4.	Student will able to think about practical aspect of computational modelling of flow domains in CFD Software

	Course Contents	Hours
Unit 1	**Introduction to CFD**: Computational approach to fluid dynamics and its comparison with experimental and analytical method **Basics of PDE:** Elliptical, Parabolic and Hyperbolic equations	**(07)**
Unit 2	**Governing Equations:** Review of Navier-Stokes equation and simplified forms, Energy equation, **Discretization Techniques**: FDM and FVM with special emphasis on FVM, Stability, Convergence, Accuracy	**(07)**
Unit 3	**Finite Volume Method**: Domain Discretization, Types of mesh and quality of mesh, SIMPLE, Pressure Velocity Coupling, Checkerboard pressure filed and Staggered grid approach	**(07)**
Unit 4	**Geometry Modelling and Grid Generation:** Practical aspects of computational modelling of flow domains and grid generation, Types of mesh and selection criteria, Mesh quality attributes and their importance	**(08)**
Unit 5	**Methodology of CFDHT:** Objectives and importance of CFD Heat Transfer, CFDHT for Diffusion equation convection equation and Convection- Diffusion equation.	**(06)**
Unit 6	**Solution of N-S Equation for Incompressible Flow:** Semi-Explicit and Semi-Implicit, Algorithm for Staggered grid system and Non Staggered Grid System of NS Equations for Incompressible Flows	**(07)**

Text Books

1.	**John A Anderson:** Computational Fluid dynamics, The Basic with applications, McGraw-Hill International edition, subject is like having new tool to students Mechanical Engineering series
2.	**Dr. Suhas Patankar:** Numerical Methods in Fluid flow and Heat Flow
3.	**H. K Versteeg, W. Malalasakera:** An Introduction to computational fluid flow (Finite Volume Method), Printice Hall Pub

Reference Books

1.	**Ferziger and Peric:** Computational Method for Fluid Dynamics, Springer Publication
2.	**Chuen-Yen Chow:** An Introduction to Computational Fluid Dynamics , Wiley Publications
3.	**Murlidhar and Sundarrajan:** Computational Fluid Flow and Heat Transfer Narosa Publication

Useful Links

1.	http://www.sciencedirect.com/science/article/pii/S0017931002002235
2.	http://www.ewp.rpi.edu/hardford/~ernesto/F2012/.../Patankar- NHTFF-1980.pdf
3.	www.cfd.com.au/cfd_conf09/PDFs/001EJL.pdf
4.	http://www.thermalfluidscentral.org/e-books

First Year (Sem – II) M. Tech. Mechanical-Heat Power Engineering

HP1224: Design of Solar and Wind system (Elective-IV)

Teaching Scheme			Examination Scheme	
Lectures	03Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of course student will be able to **:**

1.	Understand current scenario of Renewable energy in India and World.
2.	Able to analyse different Renewable energy systems.
3.	Analyze various techno economical obstacles in the commercial development of Renewable energy in India.
4.	Conceptually model and design general Renewable energy systems and predict the long term performance.
5.	Design and plan hybrid Renewable energy solutions to conventional energy systems.
6.	Update about the technological status of implementation of Renewable energy in India.

	Course Contents	Hours
Unit 1	**Introduction-** Man and energy, World's production and reserves of commercial energy sources, India production and reserves. Energy alternatives.	**(04)**
Unit 2	**Solar Radiation-** Structure of the sun, energy radiated by the sun, angular relationship of earth, and sun position, measurement of solar radiation. Derivations and Numerical Problems	**(06)**
Unit 3	**Design of Flat Plate Collectors and Solar Concentrator-** Types and Design of constructional details of flat plate collector, Energy- simple equation and performance curves, selection of flat plate collector, Limitations of flat plate collectors ,Design of various types of concentrators: selection of various materials for concentrators and reflecting surfaces and designing	**(08)**
Unit 4	**Design of Solar Heating Systems -** Solar water and space heating systems, passive solar heating systems, solar heating economics, solar air-heating systems, typical solar ponds. Design of Various solar stills and selection, constructional details, Solar Energy Storage Systems, Design of solar photovoltaic system, materials used and their performance.	**(08)**
Unit 5	**Wind Energy -** Introduction, History of wind power, Principles of wind power, wind turbine operation, site characteristics, New development in small and large machines, The Magnus effect, The Madaras rotor wind machine, The Darrieus machine	**(07)**
Unit 6	**Other Renewable sources-** Chemistry of biogas generation, variables affecting simple gas plants, types of digesters, their working and construction, application of biogas, use of bio-gas, case study of "Pura" village bio gas electricity generation". Fuel cells, thermionic, thermoelectric, Geothermal energy.	**(07)**

Text Books

1.	Sukhatme S.P., " Solar Energy", Tata McGraw Hill Publishing Company Limited, New Delhi, 1994
2.	Rai G.D., " An Introduction to Power Plant Technology", Khanna Publishers, Third Edition, Delhi, 1996
3.	Powerplant Technology by M.M.EI-Wakil, McGraw-Hill International.

Reference Books

1.	S. Rao and Dr. B. B. Parulekar, Energy Technology, Khanna Publishers, New Delhi.
2.	Krieth and Krieder, "principles of solar engineering", Tata McGraw Hill Publishing Company Limited, New Delhi, 1994
3.	Wakil M.M., " Power Plant Technology", McGraw Hill InternationalBook Company, 1984.
4.	Pai B.K., and Ramprasad M.S., " Power generation through renewable sources of energy
5.	Garg H.P. and Prakash J., " Solar Fundamental and Application" Tata McGraw Hill Publishing Company Limited, New Delhi, 1997

Useful Links

1.	www.nptel.ac.in/courses/112105051
2.	www.sciencedirect.com/science/book/9780123749918
3.	www.elsevier.com/books/renewable-energy-system-design

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical-Heat Power Engineering

HP 1234: Energy Analysis of Thermal System (Elective-IV)

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of the course:

1.	Student will familiarize with various aspects of Thermal System Design.
2.	Student will aware of Thermodynamic modeling and design analysis.
3.	Students will analyze thermal systems to evaluate and improve its thermodynamic effectiveness.
4.	Students will simulate the thermal systems using computer based various software's.
5.	Students will able to design of piping's and pump selection in thermal system applications.
6.	Students will optimize the thermal systems with Thermo-economic analysis and evaluation.

	Course Contents	Hours
Unit 1	**Introduction to Thermal System Design:** Introduction; Workable, optimal and nearly optimal design; Thermal system design aspects; concept creation and assessment; Computer aided thermal system design.	**(05)**
Unit 2	**Energy accounting**: energy balance for closed system, Energy analysis of cycle, control volume energy analysis, conservation of mass and energy for control volume, analysis of control volume at steady state, transient analysis, Entropy balance and entropy rate balance for closed systems.	**(07)**
Unit 3	**Exergy Analysis**: Defining exergy, closed system exergy balance, flow exergy, Exergy rate balance for control volume, Energetic (IInd law efficiency), Thermodynamics- Exergy in design.	**(07)**
Unit 4	**Heat transfer modeling and design analysis**: Review of heat transfer processes involving conduction, convection and radiation and the corresponding heat transfer equations used in the design. Conduction, convection, radiation, conduction heat transfer in stationary medium, unsteady state heat conduction, convection heat transfer – approximation and special conditions, Radiation heat transfer – radiation exchange between diffuse, gray surfaces in an enclosure.	**(07)**
Unit 5	**Design of piping and pump systems**: Head loss representation, Piping networks ; Hardy – Cross method ; Generalized Hardy – Cross analysis; Pump testing methods; Cavitation considerations, Dimensional analysis of pumps; piping system design practice.	**(07)**
Unit 6	**Thermo-economic analysis and evaluation**: Fundamentals of thermo-economics, Thermo-economic variables for component evaluation; thermo-economic evaluation; additional costing considerations.	**(07)**

Text Books

1.	**Thermal Design & Optimization -** Bejan, A., et al., John Wiley, 1996
2.	**Analysis & Design of Thermal Systems -** Hodge, B.K., 2nd edition, Prentice Hall,1990.
3.	**Fundamentals of Engineering Thermodynamics**- Michael J. Moren,et al., 4 th Edition, John Wiley & Sons. Inc.

Reference Books

1.	**Design of Thermal Systems -** Boehm, R.F., John Wiley, 1987
2.	**Design of Thermal Systems -** Stoecker, W.F., McGraw-Hill
3.	**Thermodynamics and Energy Systems Analysis** – Lucien Borel and Daniel Favrat, EPFL Press, A Swiss academic publisher distributed by CRC Press

Useful Links

1.	http://www.eolss.net/sample-chapters/c08/e3-03-30.pdf
2.	http://www.nptel.ac.in/courses/112106064
3.	http://www.sciencedirect.com/science/article/pii/S0196890402001796

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical-Heat Power Engineering

HP1215: Engineering Experimental Techniques (Elective-V)

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of the course student will able to:

1.	Understand scope and limitation of experimental techniques
2.	Analyse experimental data
3.	Analysis experimental observation using statistical tools
4.	Selection of appropriate measuring equipment
5.	Select appropriate thermal measuring sensors
6.	Select data acquiring and storage systems

	Course Contents	Hours
Unit 1	Basic Concepts: Definition of terms, Calibration, Standards, Dimensions and units, the generalized measurement system, Basic concepts in dynamic measurements, system response, distortion, impedance matching, experimental planning.	**(06)**
Unit 2	Analysis of Experimental Data: Causes and types of experimental errors, uncertainty analysis, evaluation of uncertainties for complicated data reduction	**(06)**
Unit 3	Statistical analysis of experimental data, probability distributions, the Gaussian, normal error distribution, probability graph paper, the Chi-square test of Goodness of fit, The method of least squares, the correlation coefficient, standard deviation of the mean, t-distribution, Graphical analysis and curve fitting, general considerations in data analysis.	**(08)**
Unit 4	Force Torque and Strain Measurements: Mass balance measurements, elastic elements of force measurements, torque measurement, stress strain measurements, various types of strain gauges, Motion and Vibration measurement: Simple vibration instruments, principles of the seismic instruments, practical considerations of seismic instruments, sound measurements.	**(07)**
Unit 5	Pressure, Temperature, Heat flux, Thermal conductivity measurement, various transducers, selection of measuring instruments.	**(06)**
Unit 6	Data Acquisition and Processing: The general data acquisition system, signal conditioning, data transmission, analog to digital and digital to analog conversions, data storage and display, the program as substitute for wired logic.	**(07)**

Text Books

1.	Jain R. K., "Mechanical Measurements", Khanna Publishers, New Delhi, 2018
2.	Sawhney A K, " A course in electrical and electronic measurement and instrumentation", Dhanpat Rai pub, Delhi, 2012
3.	Nakra B C, Chaudhary K K, "Instrumentation Measurement and Analysis" McGraw-Hill Publication, 4th edition, 2016

Reference Books

1.	Ernest O Doebelin " Measurement system" McGraw-Hill Publication, 6th edition, 2017
2.	Holman J. P., "Experimental Methods for Engineers", 9th Ed, McGraw Hill Publications, New York, 2015

Useful Links

1.	https://nptel.ac.in/courses/112105117/13
2.	https://nptel.ac.in/courses/112105117/4
3.	https://nptel.ac.in/courses/112105166/28

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical-Heat Power Engineering

HP1225: Adv. I.C. Engines (Elective-V)

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	01 Hrs/week		CT – 2	15
Total Credits	04		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of the course student will able to:

1.	To familiarize the students with latest developments in Advanced I.C. Engines to cope up with requirements of industry.
2.	To familiarize the students with developments in Advanced I.C. Engines
3.	To provide a technical understanding of common engineering processes related with Advanced I.C. Engines
4.	To provide a technical understanding of use of computer and advanced tools related with Advanced I.C. Engines

	Course Contents	Hours
Unit 1	**Spark Ignition Engines** Air-fuel ratio requirements, Design of carburetor –fuel jet size and venturi size, Stages of Combustion-normal and abnormal combustion, Factors affecting knock, Combustion chambers, Introduction to thermodynamic analysis of SI Engine combustion process	**(07)**
Unit 2	**Compression Ignition Engines** Stages of combustion-normal and abnormal combustion – Factors affecting knock, Direct and Indirect injection systems, Combustion chambers, Turbocharging, Introduction to Thermodynamic Analysis of CI Engine Combustion process	**(07)**
Unit 3	**Engine Exhaust Emission Control** Formation of NOX, HC/CO mechanism, Smoke and Particulate emissions, Green House Effect, Methods of controlling emissions, Three way catalytic converter and Particulate Trap, Emission (HC, CO, NO and NOx) measuring equipments, Smoke and articulate measurement, Indian Driving Cycles and emission norms like Bharat Stage norms BS VI	**(07)**
Unit 4	**Alternate Fuels** Alcohols, Vegetable oils and bio-diesel, Bio-gas, Natural Gas, Liquefied Petroleum Gas, Hydrogen, Properties, Suitability, Engine Modifications, Performance, Combustion and Emission Characteristics of SI and CI Enginesusing these alternate fuels	**(06)**
Unit 5	**Recent Trends** Homogeneous Charge Compression Ignition Engine, Lean Burn Engine, Stratified Charge Engine, Surface Ignition Engine, Four Valve and Overhead cam Engines, Electronic Engine Management, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine, Data Acquisition System –pressure pick up, charge amplifier PC for Combustion and Heat release analysis in Engines	**(07)**

Tutorials:-- Eight assignments on above syllabus.

Text Books

1.	John B Heywood, “Internal Combustion Engine Fundamentals”, Tata McGraw-Hill
2.	Patterson D.J. and Henein N.A., “Emissions from combustion engines and their control”, Ann Arbor Science publishers Inc, USA
3.	Gupta H.N, “Fundamentals of Internal Combustion Engines”, Prentice Hall of India

Reference Books

1.	Ultrich Adler, “Automotive Electric / Electronic Systems”, Robert Bosh GmbH
2.	V. Ganeshan, “ Internal Combustion Engines”, Tata McGraw-Hill
3.	C.F.Taylor, The internal combustion engines theory and practice, vol. I & II, MIT press
4.	Colib R, Furguson, Internal Combustion Engine, Applied Thermosciences, John Willey and Sons,
5.	E.F Obert, Internal combustion engines, Addison Wesley, 3rd Edition

Useful Links

1.	http://www.slideshare.net/ravirajan1257/advanced-ic-engines-unit
2.	https://www.erc.wisc.edu
3.	http://www.scientific.net

4.	http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/28890yy.pdf
5.	https://swayam.gov.in/nd1_noc20_me42/preview
6.	https://onlinecourses.iitk.ac.in/course/me359
7.	https://nptel.ac.in/courses/112/104/112104033/
8.	https://nptel.ac.in/courses/112/103/112103262/

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical-Heat Power Engineering

HP1235: Design of Pumps, Compressors and Blowers (Elective-V)

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of the course student will able to:

1.	To familiarize the students with latest developments in Pumps, compressors and blowers to cope up with requirements of industry.
2.	To familiarize the students with developments in Pumps, compressor and blowers
3.	To provide a technical understanding of common engineering processes related with Pumps, compressor and blowers
4.	To provide a technical understanding of use of computer and advanced tools related with Pumps, compressor and blowers

	Course Contents	**Hours**
Unit 1	**Centrifugal and Axial Flow Pumps** Law of momentum, Vortex theory of Euler's head. Hydraulic performance of pumps; Cavitation, Jet pumps. The centrifugal pump, definitions, pump output and efficiency, multistage centrifugal pumps, axial flow pump, Design of pumps	**(06)**
Unit 2	**Power Transmitting Turbo-machines**, Introduction, theory, fluid of hydraulic coupling, torque converter.	**(07)**
Unit 3	**Rotary fans and blowers** Introduction, Centrifugal blower, types of Vane shapes, Size and speed of Machine, Vane shape: efficiency, stresses, and characteristics. Actual performance characteristics, the slip co-efficient, Fan laws and characteristics.	**(06)**
Unit 4	**Turbo blowers and their characteristics**. Cooling tower fan, Surging Design of blower sand fans.	**(07)**
Unit 5	**Axial Compressors:** Stage velocity triangles, enthalpy – entropy diagrams, flow through blade rows, stage losses and efficiency, work done factor, low hub-tip ratio stages, supersonic and trans sonic stages, performance characteristics, problems and design.	**(06)**
Unit 6	**Centrifugal Compressors:** Elements of centrifugal compressor stage, stage velocity diagrams, enthalpy-entropy diagram, nature of impeller flow, slip factor, diffuser, volute casing, stage losses, performance characteristics, problems and design.	**(07)**

Text Books

1.	A.J. Stepanoff, Centrifugal and Axial /flow Pumps, Wiley, 1962.
2.	A. Kovats, Design and Performance of Centrifugal and Axial Flow Pumps and Compressors, Oxford, Pergamon, 1958
3.	V. Kadambi and Manohar Prasad: "An Introduction to energy conversion VolumeIII,2002

Reference Books

1.	S M Yahya: "Turbines, Compressors and Fans", Second Edition
2.	V Ganesan: "Gas Turbines", 2002.

Useful Links

1.	http://ebooks.narotama.ac.id/files/Mechanical
2.	http://www.conceptsnrec.com/conceptsnrec/media/data.../cn_eng_services.pdf
3.	http://www.textofvideo.nptel.iitm.ac.in/103104044/lec1.pdf
	http://www.gastmfg.com/catalogs/F-5_Rotary_Vane_Feb17-2012_lores.pdf

Government College of Engineering, Karad

M. Tech. (Sem.-II) Mechanical- Heat Power Engineering

HP 1206: Lab Practice III

Teaching Scheme			Examination Scheme	
Practicals	04 Hrs/week		CA	25
Total Credits	02		ESE	25

Lab Outcomes (LO)

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

Experiments

1.	To study LMTD values for parallel and counter flow heat exchanger
2.	To apply effectiveness NTU method for parallel and counter flow heat exchanger
3.	To design electrical water heater for domestic application
4.	To design solar water heater for domestic application
5.	Determination of quality of steam using combined separating and throttling calorimeter
6.	Exergy analysis of steam power plant
7.	Performance evaluation of cascade refrigeration system
8.	Industrial visit of some thermal installation

Government College of Engineering, Karad

M. Tech. Heat Power Engineering

HP 1207: Lab Practice IV

Teaching Scheme			Examination Scheme	
Practicals	04 Hrs/week		CA	25
Total Credits	02		ESE	25

Lab Outcomes (LO)

1.	Students will acquire hands on experience on the various softwares used in thermal industrial applications
2.	Students should able to analyse the various technical parameters in thermal applications by mathematical relationship.
3.	Students will able to identify the effect of various parameters on the system and able to co- relate them using ANSYS and FLUENT

Experiments

Total 8 Experiments on following core/Elective-III & IV courses using ANSYS & CFD software

1) Advanced Fluid Dynamics
2) Steam Engineering
3) Elective-III
4) Elective-IV

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical- Heat Power Engineering

HP 1208: Seminar on Pre- Dissertation work

Teaching Scheme			Examination Scheme	
Lectures	-		CT – 1	-
Tutorials/Practical	04 Hr/week		CT – 2	-
Total Credits	02		TA	50
			ESE	50
			-	-

Course Outcomes (CO)

At the end of the course:

1.	Students will get an opportunity 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.	Students will learn to write technical reports.
4.	Students will develop skills to present and defend their work in front of technically qualified audience.

Course Contents

Guidelines:

Students can take up small problems in the field of Thermal 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.

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical- Production Engineering

AU1219: Constitution of India (Audit Course – II)

Teaching Scheme			Examination Scheme	
Lectures	02 Hrs/week		CT – 1	--
Tutorials	-		CT – 2	--
Total Credits	00		TA	--
			ESE	--
			Duration of ESE	--

Course Outcomes (CO)

At the end of the course, the students will be able to

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.

	Course Contents	Hours
Unit 1	**History of Making of the Indian Constitution** History Drafting Committee, (Composition & Working)	**(04)**
Unit 2	**Philosophy of the Indian Constitution** Preamble Salient Features	**(04)**
Unit 3	**Contours of Constitutional Rights & Duties** Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.	**(04)**
Unit 4	**Organs of Governance** Parliament, Composition, Qualifications and Disqualifications, Powers and Functions Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions	**(04)**
Unit 5	**Local Administration** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. 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	**(04)**
Unit 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	**(04)**

Text Books

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.

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical- Production Engineering

AU1229: Pedagogy Studies (Audit Course – II)

Teaching Scheme			Examination Scheme	
Lectures	02 Hrs/week		CT – 1	--
Tutorials	-		CT – 2	--
Total Credits	00		TA	--
			ESE	--
			Duration of ESE	--

Course Outcomes (CO)

At the end of the course, the students will be able to understand

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?

	Course Contents	Hours
Unit 1	**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.	**(04)**
Unit 2	**Thematic overview** Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.	**(02)**
Unit 3	**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.	**(04)**
Unit 4	**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	**(04)**
Unit 5	**Research gaps and future directions** Research design, Contexts 2 Model Curriculum of Engineering & Technology PG Courses [Volume-I] [46], Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.	**(04)**

Text Books

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.

Reference Books

	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
	Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
	Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

Useful links

www.pratham.org/images/resource%20working%20paper%202.pdf

Government College of Engineering, Karad

Second Year (Sem – III) M. Tech. Mechanical- Heat Power Engineering

HP 1301: Dissertation Phase I

Teaching Scheme			Examination Scheme	
Lectures	-		CT – 1	-
Tutorials/Practical	32 Hr/week		CT – 2	-
Total Credits	16		TA	50
			ESE	50
			-	-

Course Outcomes (CO)

At the end of the course:

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

Course Contents

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.

Government College of Engineering, Karad				
Second Year (Sem – III) M. Tech. Mechanical- Heat Power Engineering				
HP 1302: MOOC online course				
Teaching Scheme			**Examination Scheme**	
Lectures	--		-	
Practicals	-		-	
Total Credits	03			

Online courses available on digital platform like Moocs/ NPTEL/ Coursera etc., during the academic semester will be reviewed and listed by departmental faculty board before start of every semester. Suitable course for registered candidate will be recommended by seminar / dissertation guide and programme head considering skill sets and knowledge required for dissertation work of the individual candidate from the list. It shall have minimum 8-12 weeks duration, peer graded assignment and examination to award grade by online course offering agency. It will be approved by Program Head case to case.

In case online course is not available, departmental committee will specially design syllabus for course under self-learning mode and guide will conduct end semester examination to award the grade.

Government College of Engineering, Karad

Second Year (Sem – IV) M. Tech. Mechanical- Heat Power Engineering

HP 1401: Dissertation Phase II

Teaching Scheme			**Examination Scheme**	
Lectures	-		CT – 1	-
Tutorials/Practical	32 Hr/week		CT – 2	-
Total Credits	16		TA	100
			ESE	200
			-	-

Course Outcomes (CO)

At the end of the course:

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

Course Contents

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.