Curriculum and Syllabus

B. TECH.

Mechanical Engineering

(Applicable for 2020-21 batch onwards)

Department of Mechanical Engineering
School of Engineering and Technology,
H. N. B. Garhwal University,
Srinagar Garhwal, Uttarakhand- 246174

Curriculum

Definitions/ Descriptions

1. **Credit Equivalent**

	No. of Contact Hours per Week	Equivalent Credits
Lecture+ Tutorial	4/3	3
Practical	2	1

2. **Induction Program:**

Induction Program (mandatory)	**3 weeks duration**
Induction program for students to be offered right at the start of the first year.	**Activities:** (i) Physical activity (ii) Creative Arts (iii) Universal Human Values (iv) Literary (v) Proficiency Modules (vi) Lecture by Eminent People (vii) Visits to local Areas (viii) Familiarization to Dept./Branch & Innovations

***Induction program for students to be offered right at the start of the first year. Appendix –I sheet has attached for details.**

3. **Code for Courses:**

Code for a course consists of two alphabets followed by three digits and an optional alphabet.
First three alphabet represent the school name (SET: School of Engineering and Technology) next two alphabets in the code represent the subject area of the course. E.g. (SH: Applied Science and Humanities, EC: Electronics and Communication Engineering, IN: Instrumentation Engineering, EE: Electrical Engineering, ME: Mechanical Engineering, CS: Computer Science and Engineering, IT: Information Technology, AECC: Ability Enhancement Compulsory Courses). Then there will be subject code with 4 letters out of which first will tell the nature of subject (C: Core; E: Elective; S: Skill Enhancement) and next three letters will tell the number according to the semester(for example 801 will tell its 8^{th} semester subject). First digit represents the semester. Next two digits represent the sequence number of course in the list of courses of a semester.

Elective Course:
Elective courses are provided in VII and VIII semesters to provide student with flexibility to choose courses of their interest from a list of offered electives. These Electives are the courses offered by the same department or other departments for the students.

Semester-wise list of subjects

Semester I

S. No.	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	SET/SH/BT/C101	Mathematics I	3	1	-	4	3
2	SET/SH/BT/C102	Physics	3	1	-	4	3
	SET/SH/BT/C203	Chemistry					
3	SET/EE/BT/C103	Basic Electrical Engineering	3	1	-	4	3
	SET/ME/BT/C202	Basic Mechanical Engineering					
4	SET/EC/BT/C104	Basic Electronics	3	1	-	4	3
	SET/ME/BT/C204	Engineering Mechanics					
5	SET/IT/BT/C105	Fundamentals of Information Technology	3	1	-	4	3
	SET/CS/BT/C205	Computer Programming					
6	AECC106	*Environmental Science	2	-	-	2	2
7	SET/SH/BT/C106	Physics Lab	-	-	2	2	1
	SET/SH/BT/C207	Chemistry Lab					
8	SET/EE/BT/C107	Basic Electrical Engineering Lab	-	-	2	2	1
	SET/ME/BT/C206	Basic Mechanical Engineering Lab					
9	SET/IT/BT/C108	Information Technology Lab	-	-	2	2	1
	SET/CS/BT/C208	Computer Programming Lab					
10	SET/ME/BT/S109	**Engineering Graphics	-	-	4	4	2
Total			17	5	10	32	22

* Ability Enhancement Compulsory Course.
**Skill Enhancement Course.

Semester II

S. No.	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	SET/SH/BT/C201	Mathematics II	3	1	-	4	3
2	SET/ME/BT/C202	Basic Mechanical Engineering	3	1	-	4	3
	SET/EE/BT/C103	Basic Electrical Engineering					
3	SET/SH/BT/C203	Chemistry	3	1	-	4	3
	SET/SH/BT/C102	Physics					
4	SET/ME/BT/C204	Engineering Mechanics	3	1	-	4	3
	SET/EC/BT/C104	Basic Electronics					
5	SET/CS/BT/C205	Computer Programming	3	1	-	4	3
	SET/IT/BT/C105	Fundamentals of Information Technology					
6	AECC206	* General English	2	-	-	2	2
7	SET/ME/BT/C206	Basic Mechanical Engineering Lab	-	-	2	2	1
	SET/EE/BT/C107	Basic Electrical Engineering Lab					
8	SET/SH/BT/C207	Chemistry Lab	-	-	2	2	1
	SET/SH/BT/C106	Physics Lab					
9	SET/CS/BT/C208	Computer Programming Lab	-	-	2	2	1
	SET/IT/BT/C108	Information Technology Lab					
10	SET/ME/BT/S209	**Engineering Workshop	-	-	4	4	2
Total			17	5	10	32	22

* Ability Enhancement Compulsory course.
**Skill Enhancement Course.

Semester III

S. No.	Code	Course Title	L	T	P	Contact Hrs. /Week	Credits
1	SET/SH/BT/C301	Mathematics-III	3	1	-	4	3
2	SET/ME/BT/C302	Strength of Materials	3	1	-	4	3
3	SET/ME/BT/C303	Fluid Mechanics	3	1	-	4	3
4	SET/ME/BT/C304	Engineering Thermodynamics	3	1	-	4	3
5	SET/ME/BT/C305	Material Science	3	1	-	4	3
6	SET/ME/BT/C306	Fluid Mechanics Lab	-	-	2	2	1
7	SET/ME/BT/C307	Material Science & Testing Lab.	-	-	2	2	1
8	SET/ME/BT/C308	Machine Drawing & Auto-CAD Lab	-	-	4	4	2
9	SET/ME/BT/S309	*****Electrical Machines Lab			4	4	2
			15	5	12	32	21

***Skill Enhancement Course.**

Semester IV

S. No.	Code	Course Title	L	T	P	Contact Hrs. /Week	Credits
1	SET/ME/BT/C401	Kinematics of Machines	3	1	-	4	3
2	SET/ME/BT/C402	Manufacturing Technology	3	1	-	4	3
3	SET/ME/BT/C403	Measurement, Metrology & Control	3	1	-	4	3
4	SET/ME/BT/C404	Applied Thermodynamics	3	1	-	4	3
5	SET/ME/BT/C405	Advance Strength of Materials	3	1	-	4	3
6	SET/ME/BT/C406	Manufacturing Technology Lab.	-	-	4	4	2
7	SET/ME/BT/C407	Measurement, Metrology & Control Lab.	-	-	2	2	1
8	SET/ME/BT/C408	Applied Thermodynamics Lab.	-	-	2	2	1
9	SET/ME/BT/S409	*****AutoCAD 3D and ANSYS Lab.	-	-	4	4	2
			15	05	12	32	21

***Skill Enhancement Course.**

Semester V

S. No.	Code	Course Title	L	T	P	Contact Hrs. /Week	Credits
1	SET/ME/BT/C501	Machine Design-I	3	1	0	4	3
2	SET/ME/BT/C502	Dynamics of Machines	3	1	0	4	3
3	SET/ME/BT/C503	Advance Manufacturing Process and Automation.	3	1	0	4	3
4	SET/ME/BT/C504	Refrigeration & Air Conditioning	3	1	0	4	3
5	SET/ME/BT/C505	Mechanical Vibration	3	1	0	4	3
6	SET/ME/BT/S506	*Industrial Engineering & Management	2	1	0	3	2
7	SET/ME/BT/C507	Machine & Mechanism Lab.	0	0	2	2	1
8	SET/ME/BT/C508	Refrigeration & Air Conditioning Lab.	0	0	2	2	1
9	SET/ME/BT/C509	Mechanical Vibration lab	0	0	2	2	1
10	SET/ME/BT/C510	Seminar	0	0	2	2	1
			17	06	08	31	21

***Skill Enhancement Course.**

Semester VI

S. No.	Code	Course Title	L	T	P	Contact Hrs. /Week	Credits
1	SET/ME/BT/C601	Machine Design-II	3	1	0	4	3
2	SET/ME/BT/C602	IC Engines	3	1	0	4	3
3	SET/ME/BT/C603	Heat & Mass Transfer	3	1	0	4	3
4	SET/ME/BT/C604	Fluid Machinery	3	1	0	4	3
5	SET/ME/BT/C605	Operation Research Techniques	3	1	0	4	3
6	SET/SE/BT/S606	*Non Destructive Testing	2	1	-	3	2
7	SET/ME/BT/C607	Machine Design Lab.	0	0	2	2	1
8	SET/ME/BT/C608	Heat & Mass Transfer Lab.	0	0	2	2	1
9	SET/ME/BT/C609	Fluid Machinery Lab	0	0	2	2	1
10.	SET/ME/BT/C610	Mini Project	0	0	2	2	2
			17	06	08	31	21

***Skill Enhancement Course.**

Semester VII

S. No.	Code	Course Title	L	T	P	Contact Hrs. /Week	Credits
1	SET/ME/BT/C701	Automobile Engineering	3	1	0	4	3
2	SET/ME/BT/C702	CNC Machines and Programming	3	1	0	4	3
3	SET/ME/BT/C703	Finite Element Methods	3	1	0	4	3
4		Elective-I/MOOCs	3	1	0	4	3
5		Elective-II	3	1	0	4	3
6	SET/ME/BT/C710	Automobile & IC Engines Lab	0	0	2	2	1
7	SET/ME/BT/C711	CNC Machines and Programming Lab.	-	-	4	4	2
8	SET/ME/BT/C712	Project Preparation	0	0	4	4	2
9.	SET/ME/BT/C713	Industrial Training Seminar	0	0	2	2	1
			15	05	12	32	21

	S. No.	**Code**	**Course Title**
Elective I	1	SET/ME/BT/E704	Unconventional Manufacturing Processes
	2	SET/ME/BT/E705	Advance Welding Technology
	3	SET/ME/BT/E706	Computer Integrated Manufacturing Systems
	4	SET/ME/BT/MOOCs	MOOCs (12 Weeks Duration)

	S. No.	**Code**	**Course Title**
Elective II	1	SET/ME/BT/E707	Product Design and Development
	2	SET/ME/BT/E708	Turbo Machines
	3	SET/ME/BT/E709	Mechatronics

Semester VIII

S. No.	Code	Course Title	L	T	P	Contact Hrs. /Week	Credits
1	SET/ME/BT/C801	Power Plant Engineering	3	1	0	4	3
2	SET/ME/BT/C802	CAD/CAM and Robotics	3	1	0	4	3
3		Elective III	3	1	0	4	3
4		Elective IV	3	1	0	4	3
5	SET/ME/BT/C809	CAD/CAM and Robotics. Lab	0	0	2	2	1
6		Elective III Lab	0	0	2	2	1
		Elective IV Lab	0	0	2	2	1
7	SET/ME/BT/C816	Major Project	0	0	12	12	6
			12	04	18	34	21

	S. No.	**Code**	**Course Title**
Elective III	1	SET/ME/E803	Composite Material Technology
	2	SET/ME/E804	Optimization Techniques in Engineering
	3	SET/ME/E805	Experimental Stress Analysis
Elective III Lab	1	SET/ME/E810	Composite Material Technology Lab.
	2	SET/ME/E811	Optimization Techniques in Engineering lab.
	3	SET/ME/E812	Experimental Stress Analysis Lab.

	S. No.	**Code**	**Course Title**
Elective IV	1	SET/ME/E806	Non-conventional Energy Resources and utilization
	2	SET/ME/E807	Nano Materials Processing and Properties
	3	SET/ME/E808	Flexible Manufacturing System
Elective IV Lab.	1	SET/ME/E813	Non-conventional Energy Resources and utilization Lab.
	2	SET/ME/E814	Nano Materials Processing and Properties Lab.
	3	SET/ME/E815	Flexible Manufacturing System Lab.

Note

(1) Topic for the Seminar in 5^{th} semesters shall be chosen by students in consultation with faculty. Topic shall not be mentioned in the syllabus anywhere, however, it should be related to Mechanical Engineering.

(2) Mini Project work can be carried out individually or by a group of maximum of four students under the guidance of faculty. A committee of examiners will evaluate the projects.

(3) Students shall choose 2 elective subjects in 7^{th} and 8^{th} semester each from the given Table. An elective subject shall be offered only when at least 30% of the intake opts for that subject.

(4) Major Project work shall be carried out during the 7^{th} and 8^{th} semester. Students can undertake Major Project individually or in group of not more than four students, under the guidance of a faculty or a group of faculty. Students have to present Synopsis of Major Project during the 7^{th} semester. Feasibility of the Project shall be assessed by the project evaluation committee of the department before the end of 7^{th} semester. However, Major Project would be evaluated in the end of 8^{th} semester.

Detailed Syllabi

SEMESTER I

S. No.	Code	Course Title	L	T	P	T.A	C.T	TOT	ESE	SUB. TOTAL	Credits
1	SET/SH/BT/C101	Mathematics I	3	1	-	10	20	30	70	100	3
2	SET/SH/BT/C102	Physics	3	1	-	10	20	30	70	100	3
	SET/SH/BT/C203	Chemistry									
3	SET/EE/BT/C103	Basic Electrical Engineering	3	1	-	10	20	30	70	100	3
	SET/ME/BT/C202	Basic Mechanical Engineering									
4	SET/EC/BT/C104	Basic Electronics	3	1	-	10	20	30	70	100	3
	SET/ME/BT/C204	Engineering Mechanics									
5	SET/IT/BT/C105	Fundamentals of Information Technology	3	1	-	10	20	30	70	100	3
	SET/CS/BT/C205	Computer Programming									
6	AECC106	*Environmental Science	2	-	-	10	20	30	70	100	2
7	SET/SH/BT/C106	Physics Lab	-	-	2	30	-	30	70	100	1
	SET/SH/BT/C207	Chemistry Lab									
8	SET/EE/BT/C107	Basic Electrical Engineering Lab	-	-	2	30	-	30	70	100	1
	SET/ME/BT/C206	Basic Mechanical Engineering Lab									
9	SET/IT/BT/C108	Information Technology Lab	-	-	2	30	-	30	70	100	1
	SET/CS/BT/C208	Computer Programming Lab									
10	SET/ME/BT/S109	**Engineering Graphics			4	30	-	30	70	100	2
Total			17	5	10	180	120	300	700	1000	22

* Ability Enhancement Compulsory course.

**Skill Enhancement Course.

L - Lecture hours, T - Tutorial hours, P - Practical hours, T.A - Teacher's Assessment, C.T - Class Test, TOT - Total, ESE - End Semester Examination.

SET/SH/BT/C101. MATHEMATICS I		
Module Name	**Content**	**No. of Hrs.**
Vector Calculus	Interpretation of Vectors & Scalars, Gradient, Divergence and Curl of a Vector and Their Physical Interpretation, Gauss Divergence Theorem and Stoke's Theorem.	8
Matrices	Elementary Row and Column Transformation, Linear Dependence, Rank of Matrix, Consistency of System of Linear Equation and Solution of Linear System of Equations. Characteristic Equation, Cayley-Hamilton Theorem, Eigen Values and Eigen Vectors, Diagonalization, Complex Matrices.	13
Differential Calculus	Libnitz theorem, Partial Differentiation, Euler's Theorem, Asymptotes, Curve Tracing, Envelops and Evolutes. Change of Variables, Jacobians, Expansion of Functions of One and Several Variables. Cylindrical and Spherical Coordinate System. Approximation of Errors. Extrema of Function of Several Variables, Langrange's Method.	13
Probability and Statistics	Binomial Distribution, Normal Distribution and Poisson's Distribution. Correlation and Regression.	8
	Total No. of Hours	**42**
Textbooks	1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers. 2. H K Das, "Advanced Engineering Mathematics", S Chand. 3. Erwin Kreyszig, "Advanced Engineering Mathematics".	
References	1. Shanti Narayan, "A Text Book of Matrices", S. Chand . 2. Finney Thomas, "Calculus and Analytical Geometry", Narosa Publication House. 3. N. Piskunov, "Differential and Integral Calculus".	

SET/SH/BT/C102. PHYSICS		
Module Name	**Content**	**No. of Hrs.**
Optics	Interference: Coherent Sources, Conditions of Interference, Fresnel's Biprism Experiment, Interference in Thin Films, Newton's Rings; Single and n-Slit Diffraction, Diffraction Grating, Raleigh's Criterion of Resolution, Resolving Power of Telescope, microscope; Phenomenon of Double Refraction, Ordinary and Extra-ordinary Rays, Nicol Prism, Circularly and Elliptically Polarized Light, Fresnel Theory, Optical Activity, Specific Rotation.	13
Lasers and X-Rays	Laser: Principle of Laser Action, Einstein's Coefficients, Construction and Working of He-Ne and Ruby Laser; Introduction to Maser. Diffraction of X-Rays, Bragg's Law, Practical Applications of X-Rays, Compton Effect.	7
Basics Material Science	Introduction to crystal structure of materials, Miller indices for crystallographic planes and directions. X-ray diffraction for determination of crystal structure. Defects in solids: point, line and planar defects and their effect on properties of materials. Band theory of solids, conductors, semi-conductors and insulators, metals. Fermi Level. Magnetism: dipole moments, paramagnetism, Curie's law, magnetization and hysterisis, Ferromagnetism and Anti-Ferromagnetism. Ferro electricity and Piezoelectricity. Superconductivity in materials.	14
Electromagnetics	Ampere's Law and Displacement Current, Maxwell's Equations in Integral and Differential Forms, Electromagnetic Wave Propagation in Free Space and Conducting Media, Poynting Theorem.	8
	Total No. of Hours	**42**
Textbooks	1. Gaur, Gupta, "Engineering Physics" 2. Callister W.D., "Materials Science and Engineering: An introduction", 6th Edition, John Wiley & Sons Inc., New York 2002	
References	1. J. R. Taylor, C.D. Zafiratos and M. A. Dubson, Modern Physics for Scientists and Engineers, , 2nd Ed.,Pearson (2007) 2. Arthur Beiser, Concepts of Modern Physics, 6th Ed., TMH, (2009) 3. A.K. Ghatak : Optics 4. Subramanyam, Brijlal : Optics 5. Wehr Richords & Adiav : Physics of Atoms 6. O.Svelto : Lasers 7. D.J. Griffith : Electrodynamics 8. Robert Eisberg and Robert Resnick, Quantum Physics of atoms, Molecules, Solids, Nuclei and Particle, 2nd Ed., John Wiley(2006) 9. Raghavan V. " Materials Science and Engineering – A first course" 5th Edition, Prentice Hall, New Delhi, 1998 10. Van Vlack, LH, " Elements of Materials Science and Engineering". 6th Edition, Addison – Wesley Singapore, 1989 11. B. G. Streetman, Solid state Devices, 5th Ed., Pearson (2006) 12. Dekker, "Electrical Engineering Materials", PHI	

SET/EE/BT/C103. BASIC ELECTRICAL ENGINEERING		
Module Name	**Content**	**No. of Hrs.**
DC Networks	Concepts of linear, nonlinear, active, passive, unilateral and bilateral elements; Ideal and practical voltage & current sources – conversion from one from the other; Kirchhoff's laws – statements; Mesh Analysis; Nodal Analysis; Delta-Star & Star-Delta conversion; Superposition principle; Thevenin's theorem – statement, advantages in case of complex networks; explanation & illustration with examples; Norton's theorem, Maximum power transfer theorem, Reciprocity Theorem and its application.	10
Single Phase AC Circuits	Generation of single phase a.c. voltage and determination of average (mean) and RMS (effective) values of voltage and current with special reference to sinusoidal waveforms; Form factor and peak factor for various waves; Representation of sinusoidal time varying quantities as phasors; concepts of reactance, impedance and their representation in complex forms using j operator; Steady state analysis of series R-L-C circuit & its phasor diagram; Concept of power & power factor; Concept of admittance, susceptance in parallel circuits; Analysis of series parallel circuits & phasor diagrams; Resonance in series and parallel circuits.	10
Three Phase Circuits	Generation of 3-phase balanced sinusoidal voltage; star & delta connections; line & phase quantities (current & voltage); Solution of 3-phase star/delta circuits with balanced supply voltage and balanced load; phasor diagram; 3-phase, 4-wire circuits; Measurement of three phase power by two wattmeter method; phasor diagram with balanced load and determination of load power factor from wattmeter readings.	6
Transformers and Rotating Machines	Transformers: Constructional features and principle of operation, concept of ideal transformer under no load & loaded conditions and its equivalent circuit; Practical transformer rating & its equivalent circuit; Autotransformer – principle of operation & relative advantages & disadvantages; Rotating Machine: construction features (stator, rotor & air gap), conditions for production of steady electromagnetic torque; Three phase Induction motor: constructional features and operation; DC Machines: construction features, EMF and Torque expression, Classification of D.C. motors and generators; Stepper motor.	12
Measuring Instruments	DC PMMC instruments – constructional feature and principle of operation; Moving iron meters – construction and principle of operation; Dynamometer type wattmeter; Induction type energy meter construction & principle of operation.	6
	Total No. of Hours	**44**
Textbooks	1. I.J. Nagrath, "Basic Electrical Engineering," Tata Mc. Graw Hill.	
References	1. A. E. Fitgerald, D.E., Higginbotham and A Grabel, "Basic Electrical Engineering", Mc Graw Hill. 2. Rizzoni, Principles and Applications of Electrical Engineering, TMH. 3. V. Del Toro. "Principles of electrical Engineering, "Prentice hall. 4. W.H. Hayt & J.E. Kemmerly," Engineering circuit Analysis, "Mc Graw Hill. 5. H. Cotton, "Advanced Electrical Technology" Wheeler Publishing.	

SET/EC/BT/C104. BASIC ELECTRONICS		
Module Name	**Content**	**No. of Hrs.**
Semiconductor Diodes	Semiconductor materials- intrinsic and extrinsic types, Ideal Diode as switch, Terminal characteristics of PN diode - p-n junction under open circuit condition, p-n junction under forward bias and reverse bias conditions, p-n junction in breakdown region; Zener diode and applications e.g. voltage regulator; Rectifier Circuits, Clipping and Clamping circuits; LED, Photo Diode.	10
Bipolar Junction Transistors	Physical structure, physical operation and current-voltage characteristics of NPN transistor; Use of Voltage dependent Current source as an Voltage amplifier; Transistor as an amplifier: Characteristics of CE amplifier; Active region operation of transistor; D.C. analysis of Common Emitter Amplifier: load line analysis; Transistor as a switch: cut-off and saturation modes.	10
Field Effect Transistor	Enhancement-type MOSFET: structure and physical operation, current-voltage characteristics; MOSFET as a Switch, MOSFET as a Voltage dependent Current source and Amplifier.	8
Operation Amplifier	Ideal Op-amp; Properties of the ideal Operational Amplifier; op-amp application circuits (assuming ideal op amp): inverting amplifier, non -inverting amplifier, weighted summer, integrator, and differentiator.	6
Digital Logic and Gates	Binary, octal and hexadecimal number systems; Methods of base conversions; Binary, octal and hexadecimal arithmetic; Representation of signed numbers; Basic logic operations and logic gates; MOSFET Switch Implementation of Logic Gates e.g. Inverter, NAND, NOR. Basic postulates and fundamental theorems of Boolean algebra.	8
	Total No. of Hours	**42**
Textbooks	1. Agarwal, Anant; Lang, Jeffrey H, "Foundations of Analog and Digital Electronic Circuits", Elsevier Science & Technology Books.	
References	1. V. Del Toro, Principles of Electrical Engineering, PHI. 2. Rizzoni, Principles and Applications of Electrical Engineering, TMH.	

	3. Malvino, Electronic Principles. 4. R.L.Boylestad & L.Nashelsky, Electronics Devices & Circuit Theory, PHI.

SET/IT/BT/C105. FUNDAMENTALS OF INFORMATION TECHNOLOGY

Module Name	Content	No. of Hrs.
Introduction	Definition of Electronic Computer, History, Generations, Characteristic and Application of Computers, Classification of Computers, Computer Hardware and Basic Computer Organization: CPU- ALU, CU; RAM/ROM, Various I/O devices, Peripherals, Storage Media.	4
Computer Languages	Binary, Hexadecimal Number System; Basic Binary Logic Operations; Binary Addition and Subtraction; Generation of Languages, Assembly Language, High level language; Translators, Interpreters, Compilers, Compilers; Flow Charts, Dataflow Diagram, Pseudo codes; Assemblers, Introduction to 4GLs.	6
OS & Office	Software- System and Application Software; Elementary Concepts in Operating System; Textual Vs GUI Interface, Introduction to DOS, MS Windows.	4
Computer Networks	Elements of Communication system; Brief Introduction to Computer Networks- Introduction of LAN and WAN. Network Topologies, Client-server Architecture.	6
Internet	Internet & World Wide Web, Hypertext Markup Language, DHTML, WWW, Gopher, FTP, Telnet, Web Browsers, Net Surfing, Search Engines, Email; Introduction to Web Development, Static and Dynamic Pages.	6
IT Application and Multi media	Basic Awareness of NICNET and ERNET; E Commerce, E governance; Brief Introduction to Different Formats of Image, Audio, Video.	6
Information Concepts & Processing	Definitions of Information , Need of information, quality of information, value of information, concept of information, Entropy category and Level of information in Business Organization, Data Concepts and Data Processing, Data Representation, Application of IT to E-commerce, Electronic Governance, Multimedia, Entertainment, Introduction to Information System.	8
	Total No. of Hours	**40**
Textbooks	1. Sinha, Sinha, “Computer Fundamentals”. 2. Yadav R. P., “Information Technology”.	
References	1. D S Yadav, “Foundations of IT”, New Age, Delhi. 2. Rajaraman, “Introduction to Computers”, PHI. 3. Peter Nortans “Introduction to Computers”, TMH. 4. Patterson D.A. & Hennessy J.L., "Computer Organization and Design", Morgan Kaufmann Publishers.	

AECC106. ENVIRONMENTAL SCIENCE		
Module Name	**Content**	**No. of Hrs.**
Introduction to Environmental Sciences	Definition, scope and importance (the multidisciplinary nature of environmental science), Need for public awareness on environment, Role of individual in environmental Protection.	2
Natural Resources (Renewable and Non-Renewable Resources)	Natural Resources Conservation Concepts. Forest Resources: Present status, uses and over-exploitation, deforestation, consequences of deforestation, forest and tribal people. Fresh water resources : Use and over-exploitation of surface and ground work, conflicts over water, hydroelectric projects , problems, traditional methods of harvesting of fresh water resources. Mineral resources : use and exploitation, environmental effects of extracting mineral resources, Lime stone quarrying in Uttaranchal Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer operated problem, water logging, salinity Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Land resources: Land as a resource, land degradation, landslides, soil erosion and desertification.	6
Ecosystems	Concept, structure, and components of an ecosystem. Abiotic and biotic variables. Ecosystem function, tropic levels, energy flow, food chain, food web, Ecosystem, homeostasis. Examples of ecosystems (aquatic: pond, lake, and river). Terrestrial ecosystem: forest, mountain. Ecological succession.	4
Biodiversity and Its Conservation:	Introduction - Definition, genetic, species and ecosystem diversity. Biogeographical classification *of* India. Values of biodiversity: 5 Es (Esthetic (Aesthetic), Economic, Environmental, Ethical, Emotional. Biodiversity at global, national and local levels. India as a mega-diversity nation, hot spots *of* biodiversity Himalayan wildlife: Habitat loss poaching *of* wildlife, man wildlife conflicts, and conservation. Threatened categories as per IUCN Conservation *of* biodiversity: *In-situ* and *Ex-situ* conservation *of* biodiversity.	4
Environmental Pollution:	Definition, causes, *effects* and control measures *of* Air pollution Water pollution and thermal pollution, Marine pollution Noise and radioactive pollution Solid waste and their management (municipal, industrial (hazardous and non-hazardous), problems *of* solid waste disposal in Uttaranchal and Integrated Solid Waste Management (ISWM),Environmental hazards in Himalaya (floods, river blockades, cloud burst, landslides, earthquakes).	4
Environmental problems and Environmental Projection:	Anthropogenic and natural environmental problems. Environmental ethics: issues and possible solutions. Climate change, global warming: causes, *effects* and mitigation (national and international efforts) Ozone layer depletion: causes, effects and mitigation (national and international efforts). Issues involved in enforcement *of* environmental legislation, public awareness, Article 48 A and 51A.Automobile Emission Standards (Eco/Bharat), Ecomark.	4
Human Population and the Environment:	Population growth, variation among nations, population explosion Family Welfare Programme. Environment and human health, Role *of* Information Technology in environment and human health, **Sustainable Development:** Definition, concepts and currencies Sustainable development *of* agro-ecosystem (organic farming). Sericulture, floriculture, bee keeping. Sustainable development *of* hydro energy in Uttaranchal. Traditional Ecological Knowledge (TEK).	4
	Total No. of Hours	**28**

SET/SH/BT/C106. PHYSICS LAB		
Module	**Content**	**No. of Hrs.**
Module 1	1. To determine the wavelength of monochromatic light by Newton's ring method. 2. To determine the wavelength of monochromatic light by Fresnel's biprism. 3. To determine the focal length of two lenses by nodal slide and locate the position of cardinal points. 4. To determine the wavelength of spectral lines using plane transmission grating.	6x2
Module 2	1. Measurement of Magnetic susceptibility- Quincke's Method / Gouy's balance. 2. Mapping of magnetic field.	2x2
Module 3	1. Measurement of e/m of electron – Thomson's experiment. 2. Determination of Planck's constant.	2x2
Module 4	1. To draw hysteresis curve of a given sample of ferromagnetic material and from this to determine magnetic susceptibility. 2. To study the Hall Effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material.	4x2

	3. To determine the energy band gap of a given semiconductor material.	
	Total No. of Hours	**28**

SET/EE/BT/C107. BASIC ELECTRICAL ENGINEERING LAB		
Module	**Content**	**No. of Hrs.**
Module 1	1. Study of analog voltmeter and ammeter. 2. Study of digital multimeter. 3. Study of CRO.	3x2
Module 2	1. Verification of KCL and KVL. 2. Verification of Thevenin, Norton Network theorems. 3. Verification of Superposition Network theorem. 4. Verification of MPT Network theorem.	3x2
Module 3	1. Measurement of efficiency of a single phase transformer by load test. 2. Determination of parameters and losses in single phase transformer by OC and SC test. 3. Measurement of power in a three phase circuit by two wattmeter method. 4. Verification of Single Phase Energy Meter constant. 5. Study of thee phase induction motor.	5x2
Module 4	1. Verification of junction diode, zener diode characteristics. 2. Verification of Clipping and clamping circuits. 3. Verification of H.W. and F.W. rectifier circuit: with and without filter circuit and to determine the ripple factor. 4. Verification of CE characteristics of BJT.	4x2
	Total No. of Hours	**30**

SET/IT/BT/C108. INFORMATION TECHNOLOGY LAB		
Module	**Content**	**No. of Hrs.**
Module 1	1. Creation of a Word Document. 2. Creation of a Document in spredsheet and using Formulae. 3. Use of Search Engine and World Wide Web. 4. Creation of email id and email. 5. Use of FTP service. 6. Creation of Static Web Pages using HTML. 7. Creation of Page Using Java Script. (Besides these additional experiments can be included to give hands on experience to students. Students can be provided opportunity to work on any Information System to give them better understanding of Information System)	14x2
	Total No. of Hours	**28**

SET/ME/BT/S109. ENGINEERING GRAPHICS		
Module Name	**Content**	**No. of Hrs.**
Introduction to Engineering Graphics	Drawing instruments and their use – Different types of lines - Lettering & dimensioning – Familiarization with current Indian Standard Code of Practice for Engineering Drawing. Scales, Plain scales, Diagonal scales, Vernier scales. Introduction to orthographic projections- Horizontal, vertical and profile planes – First angle and third angle projections – Projection of points in different coordinates – Projections of lines inclined to one of the reference planes.	12
Projections of lines and planes	Projections of lines inclined to both the planes – True lengths of the lines and their angles of inclination with the reference planes – Traces of lines. Projection of plane lamina of geometric shapes inclined to one of the reference planes – inclined to both the planes, Traces of planes. Projections on auxiliary planes.	12
Projections of polyhedral and solids	Projections of polyhedral and solids of revolution, projection of solids with axis parallel to one of the planes and parallel or perpendicular to the other plane – Projections with the axis inclined to one of the planes. Projections of Solids with axis inclined to both the planes – Projections of spheres and combination of solids.	12
Sections of solids	Sections of solids by planes perpendicular to at least one of the reference planes – True shapes of sections. Developments, development of the lateral surface of regular solids like, prisms, pyramids, cylinders, cones and spheres, development of truncated solids Isometric projection – Isometric scale – Isometric views – Isometric projection of prisms, pyramids, cylinders, cones, spheres and solids made by combination of the above.	12
	Total No. of Hours	**48**
Textbooks	1. Bhatt N. D, Elementary Engineering Drawing, Charotar Publishing House, Anand, 2002.	
References	1. Narayana K L & Kannaiah P, Engineering Graphics, Tata McGraw Hill, New Delhi, 1992. 2. Luzadder W J, Fundamentals of Engineering Drawing, Prentice Hall of India, New Delhi, 2001. 3. Thomas E French & Charkes J V, Engineering Drawing & Graphing Technology, McGraw Hill Book Co, New York, 1993. 4. Venugopal K, Engineering Drawing & Graphics, New Age International Pvt. Ltd., New Delhi, 1994.	

SEMESTER II

S. No.	Code	Course Title	L	T	P	T.A	C.T	TOT	ESE.	SUB. TOTAL	Credits
1	SET/SH/BT/C201	Mathematics II	3	1	-	10	20	30	70	100	3
2	SET/ME/BT/C202	Basic Mechanical Engineering	3	1	-	10	20	30	70	100	3
	SET/EE/BT/C103	Basic Electrical Engineering									
3	SET/SH/BT/C203	Chemistry	3	1	-	10	20	30	70	100	3
	SET/SH/BT/C102	Physics									
4	SET/ME/BT/C204	Engineering Mechanics	3	1	-	10	20	30	70	100	3
	SET/EC/BT/C104	Basic Electronics									
5	SET/CS/BT/C205	Computer Programming	3	1	-	10	20	30	70	100	3
	SET/IT/BT/C105	Fundamentals of Information Technology									
6	AECC206	* General English	2	-	-	10	20	30	70	100	2
7	SET/ME/BT/C206	Basic Mechanical Engineering Lab	-	-	2	30	-	30	70	100	1
	SET/EE/BT/C107	Basic Electrical Engineering Lab									
8	SET/SH/BT/C207	Chemistry Lab	-	-	2	30	-	30	70	100	1
	SET/SH/BT/C106	Physics Lab									
9	SET/CS/BT/C208	Computer Programming Lab	-	-	2	30	-	30	70	100	1
	SET/IT/BT/C108	Information Technology Lab									
10	SET/ME/BT/S209	**Engineering Workshop	-	-	4	30	-	30	70	100	2
Total			17	5	10	180	120	300	700	1000	22

* Ability Enhancement Compulsory course.

**Skill Enhancement Course.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

SET/SH/BT/C201. MATHEMATICS II		
Module Name	**Content**	**No. of Hrs.**
Multiple Integral	Double and triple integrals, change of order of integration. Change of variables, application to area, volume, centre of gravity, moment of inertia and product of inertia. Gamma and Beta functions, Drichlet's integral and its application.	9
Fourier Series	Periodic functions, Fourier series of functions with period 2n, change of interval, half range sine and cosine series.	6
Integral Transform	Laplace transforms, existence theorem, Laplace transform derivatives, inverse Laplace transform, application to solve linear differential equations, unit step function, Dirac delta function, Laplace transforms of periodic functions. Application of Laplace transforms. Definitions of Fourier and Z-transform and its simple applications.	12
Ordinary Differential Equations	Introduction to order, degree and arbitrary constants, linear differential equations of n" order with constant coefficient, complimentary functions and particular integrals. Homogeneous differential equations, simultaneous linear differential equations. Solutions of second order differential equations by changing dependent and independent variables. Method of variation of parameters, equations of the form y" = f(y), applications to engineering problems.	12
Solutions of Equations and Curve Fitting	Solutions of cubic and bi-quadric equations. Method of least square and curve fitting.	6
	Total No. of Hours	**45**
Textbooks	1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers. 2. H K Das, "Advanced Engineering Mathematics", S Chand. 3. Erwin Kreyszig, "Advanced Engineering Mathematics".	
References	1. J. N. Kapoor, "A Text Book of Differential Equations".	

SET/ME/BT/C202. BASIC MECHANICAL ENGINEERING		
Module Name	**Content**	**No. of Hrs.**
Laws of Thermodynamics	Concept of temperature, equality of temperature, Zeroth law, principles of thermometry and temperature scale. First law of thermodynamics, concept of internal energy, application of first law to a closed system to various processes, flow processes and control volume, flow work, steady flow energy equation, mechanical work in steady flow process, throttling process, application of first law to open system. Essence of second law, thermal reservoir, heat engines and thermal efficiency. COP of heat pump and refrigerator, definition of available and unavailable energy. Statement of second law, Carnot cycle, Carnot's theorem, Clausius inequality, concept of entropy, entropy changes for ideal gases.	8
Properties of Steam	Generation of steam at constant pressure, various states of water, steam, properties of steam, use of property diagram, processes of vapour in closed and open system, determination of dryness fraction of steam by separating and throttling calorimeter, Rankine cycle.	5
Thermodynamic Cycle	Definitions of bore, stroke, clearance ratio, compression ratio, definition and calculation of mean effective pressure from the cyclic work (proof not required), indicated pressure, air standard cycle (Otto and diesel cycle), principle of working and description of two and four stroke S.I. and C.I. engine.	8
Strength of Material- Simple Stresses and Strains	Stress- tensile and compressive, strain, strain energy, stress-strain diagram, ductile and brittle material, elastic constants, impact loading, varying cross-section and load, temperature stresses, shear stress, complementary shear stress, shear strain.	8
Compound Stresses and Strains	State of stress at a point, oblique stress, simple tension, pure shear, general two dimensional stress system, principal planes, principal stresses and strains, Mohr's stress circle, Poisson's ratio, maximum shear stress.	8
Bending Stress and Torsion	Pure bending, moment of inertia, section modulus, bending stresses, combined bending and direct stress, beam of uniform strength, middle third and middle quarter rules for rectangular and circular sections, Circular shafts, torsional shear stress, strain energy in torsion, shafts under varying torque, compound shafts, combined bending and twisting.	8
	Total No. of Hours	**45**
Textbooks	1. R S Khurmi, "Engineering Mechanics". 2. P K Nag "Engineering Thermodynamics".	
References	1. Van Wylen G.J. & Sonnlog R.E.: Fundamentals of classical thermodynamics, John Wiley & Sons,Inc. NY. 2. Wark Wenneth : Thermodynamics (2nd edition), Mc Graw Hill book Co. NY. 3. Holman, J.P.: Thermodynamics, MC Graw Hill book Co. NY. 4. Yadav R.: Thermodynamics and Heat Engines, Vol I & II (Sl Edition) Central Publishing House Allahabad. 5. Yadav R.: Steam & Gas Turbines. 6. Kshitish Chandra Pal: Heat Power, Orient Longman Limited, 17, Chittranjan Avenue, Calcutta. 7. S. Rao, B.B. Parulekar, 'Energy Technology', Khanna Pub., New Delhi. 8. G. H. Ryder: "Strength of Materials". 9. F. L. Singer: "Strength of Materials". 10. Timoshenko: "Strength of Materials". 11. Beer, Johnson, Statics".	

SET/SH/BT/C203. CHEMISTRY		
Module Name	**Content**	**No. of Hrs.**
Thermodynamics	Terminology in Thermodynamics, Zeroth law of Thermodynamics, First law of Thermodynamics, Enthalpy, Reversible isothermal expansion of ideal gas, Adiabatic expansion of ideal gas, Joule-Thomson effect.	4
Lubricants	Theory, classification and mechanism of lubrication.	4
Polymers	Structures of the following polymers, viz, Natural and synthetic rubbers, Polyamide and Polyester fibres, polymethylmethacrylate, poly acrylonitrile and polystyrene. A brief account of conducting polymers (polypyrrole & polythiophene) & their applications.	3
Complex Compounds	Introduction, Valence bond and crystal field theory for bonding in complexes.	4
Chemical Kinetics & Catalysis	Order and molecularity of reactions, Catalysis- homogeneous and heterogeneous catalysis. Characteristics of catalytic reactions, catalytic promoters and poisons, auto catalysis and negative catalysis. Activation energy of catalysis, intermediate compound formation theory and adsorption theory.	3
Atmospheric Chemistry& Air Pollution	Environment and ecology, environmental segments, structure and composition of atmosphere, radiation balance of earth and Green House Effect, formation and depletion of Ozone layer, chemical and photochemical reactions of various species in atmosphere, air pollution- sources, reactions and sinks for pollutants, acid rains and smog formation. Pollution control methods.	5
Corrosion	Introduction, causes of corrosion, theories of corrosion- direct chemical attack, electrochemical theory of corrosion, factors influencing corrosion, passivity, types of corrosions, protection from corrosion (Cathodic and anodic protection) and protective metallic coatings (Galvanizing and tinning).	5
Water and Waste Water Chemistry	Introduction, Hardness of Water, Characteristics Imparted by Impurities, Determination of hardness by EDTA method, Treatment of Water by Zeolite, L-S Process, Boiler problems caused by use of hard Water, Reverse osmosis process for purification of water. Numerical based on hardness of water, zeolite process and Lime-soda process.	6
Fuels & Combustion	Classification of Fuels, Non-Conventional Energy, Biogas, and Solar Energy, Calorific value – Gross and Net, Characteristics of Good Fuel, Determination of Calorific Value by bomb calorimeter method (theory and numerical), Solid Fuels: Analysis of Coal (Proximate and ultimate analysis of coal theory and numerical), Liquid Fuels: mining and refining of petroleum, cracking (Thermal and catalytic), Knocking, octane and cetane number .	5
Stereochemistry of Organic-Compounds	Mechanism of Chemical Reaction, Beckman, Hoffman, Reimer Tiemann, Cunnizzaro, Diels- Alder and Skraup synthesis.	3
	Total No. of Hours	**42**
Textbooks	1. Jain, Jain, "Engineering Chemistry". 2. Sharma, Kumar, "Engineering Chemistry".	
References	1. R. T. Morrison and R N Boyd, "Organic Chemistry", 6th Edition, Prentice Hall, New Delhi. 2. J. D. Lee, "Concise Inorganic Chemistry", Chapman & Hall. 3. W. L. Jolly, "Modern Inorganic Chemistry", McGraw-Hill. 4. P.W. Atkins, "Physical Chemistry", 6th Edition, Oxford University Press. 5. Barrow, "Physical Chemistry". 6. Manahan, "Environmental Chemistry". 7. D. L. Pavia, GM. Lampman, GS. Kriz and J.R Vyvyan, I, "Spectroscopy", Cengage Learning India Pvt. Ltd, New Delhi, 2007. 8. R.M. Silverstein, F.X. Webster and D.J. Kiemle, "Spectrometric Identification of Organic Compounds", 7th edition, John-Wiley and Sons, New York, 2005. 9. William Kemp, "Organic Spectroscopy", 3rd edition, Palgrave, New York, 2005. 10. C.N. Banwell and E. M. McCash, "Fundamentals of Molecular Spectroscopy", McGraw- Hill, International, UK, 1995. 11. F. Carey, "Organic Chemistry", 5th Edition, McGraw Hill Publishers, Boston, 2003.	

SET/ME/BT/C204. ENGINEERING MECHANICS		
Module Name	**Content**	**No. of Hrs.**
Force System	Introduction: Force system, dimensions and units in mechanics, laws of mechanics, vector algebra, addition and subtraction of forces, cross and dot products of vectors, moment of a force about a point and axis, couple and couple moment, transfer of a force to a parallel position, resultant of a force system using vector method, Problems involving vector application Equilibrium: Static and dynamic equilibrium, static in determinacy, general equations of equilibrium, Varingnon's theorem, Lami's theorem, equilibrium of bodies under a force system, Problems.	10
Trusses And Frames	Truss and Frames: Truss, classification of truss, assumptions in truss analysis, perfect truss, analysis of perfect plane truss using method of joints and method of sections, Problems.	10
Centre Of Gravity And Moment Of Inertia	Centroid, Centre of mass and Centre of gravity, Determination of centroid, centre of mass and centre of gravity by integration method of regular and composite figures and solid objects, Problems, Moment of Inertia: Area moment of inertia, mass moment of inertia, parallel axis and perpendicular axis theorems, radius of gyration, polar moment of inertia, product of inertia, principle axis, problem based on composite figures and solid objects.	13
Kinematics And Dynamics	Kinematics: Concept of rigid body, velocity and acceleration, relative velocity, translation and rotation of rigid bodies, equations of motion for translation and rotation, problems. Particle Dynamics: Energy methods and momentum methods, Newton's laws, work energy equation for a system of particles, linear and angular momentum equations, projectile motion, problem.	12
	Total No. of Hours	**45**
Textbooks	1. R S Khurmi, "Engineering Mechanics". 2. P K Nag "Engineering Thermodynamics".	
References	1. Van Wylen G.J. & Sonnlog R.E.: Fundamentals of classical thermodynamics, John Wiley & Sons,Inc. NY. 2. Wark Kenneth: Thermodynamics (2nd edition), Mc Graw Hill book Co. NY. 3. Holman, J.P.: Thermodynamics, MC Graw Hill book Co. NY. 4. Yadav R.: Thermodynamics and Heat Engines, Vol I & II (Sl Edition) Central Publishing House Allahabad. 5. Yadav R.: Steam & Gas Turbines. 6. Kshitish Chandra Pal: Heat Power, Orient Longman Limited, 17, Chittranjan Avenue, Calcutta. 7. S. Rao, B.B. Parulekar, 'Energy Technology', Khanna Pub., New Delhi. 8. G. H. Ryder: "Strength of Materials". 9. F. L. Singer: "Strength of Materials". 10. Timoshenko: "Strength of Materials". 11. Beer, Johnson, Statics.	

SET/CS/BT/C205. COMPUTER PROGRAMMING		
Module Name	**Content**	**No. of Hrs.**
Introduction	C Character Set, Identifiers and Keywords, Data Types, Declarations, Expressions, Statements and Symbolic Constants.	6
Operators and Expressions	Arithmetic, Unary, Relational, Logical, and Assignment Operators, Conditional Operator, Library Functions.	6
Control Statements	While, Do-while, For Statements, Nested Loops, If-Else, Switch, Break, Continue and Go to Statements, Comma Operator.	5
Functions	Defining and Accessing Functions, Function Prototypes, Passing Arguments, Recursion, and Use of Library Functions.	5
Program Structure	Storage classes, Automatic, External, Static Variables.	4
Arrays	Defining and Processing, Passing to a Function, Multidimensional Arrays, Arrays and Strings.	4
Pointers	Declarations, Passing to a Function, Operations on Pointers, Pointers and Arrays, Dynamic Memory Allocation, Array of Pointers.	6
Structures and Unions	Basics of Structures, Structures and Functions, Arrays of Structures, Pointers to Structures, Self Referential Structures, type definitions, Unions.	4
Data Files	Open, Close, Create, Process, Unformatted data files.	4
	Total No. of Hours	**44**
Textbooks	1. E. Balagurusamy, "Programming in ANSI C".	
References	1. Byron S. Gottfried, "Programming With C". 2. Yashwant Kanitker, "LET US C". 3. B. W. Kernighan and D. M. Ritchie, "The C Programming Language". 4. B. W. Kernighan, "The Practice of Programming", Addison-Wesley, 1999. 5. C. L. Tondo and S. E. Gimpel, "The C Answer Book", (2/e), Prentice Hall, 1988.	

AECC206. GENERAL ENGLISH		
Module Name	**Content**	**No. of Hrs.**
Introduction:	Theory of Communication, Types and modes of Communication	-
Language of Communication	Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication	-
Speaking Skills	Monologue Dialogue Group Discussion Effective Communication/ Mis-Communication Interview Public Speech	-
Reading and Understanding	Reading and Understanding Close Reading Comprehension Summary Paraphrasing Analysis and Interpretation Translation(from Indian language to English and vice-versa) Literary/Knowledge Texts	-
Writing Skills	Documenting Report Writing Making notes Letter writing	-
	Total No. of Hours	**-**
Textbooks	1. Fluency in English - Part II, Oxford University Press, 2006. 2. Business English, Pearson, 2008. 3. Language, Literature and Creativity, Orient Blackswan, 2013. 4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas	

SET/ME/BT/C206. BASIC MECHANICAL ENGINEERING LAB		
Module	**Content**	**No. of Hrs.**
Module 1	1. Study of boiler models – Babcock Wilcox, Lancashire and Locomotive. 2. Study of Steam Engine and Steam Turbine models. 3. Study of 2-Stroke and 4-Stroke ICE models. 4. Study of vapour compression Refrigeration unit tutor. 5. Study of window type air conditioner. 6. To conduct the tensile test on a UTM and determine ultimate tensile strength, percentage elongation for a steel specimen. 7. To conduct the compression test and determine the ultimate compressive strength for a specimen. 8. To conduct impact test (Izod/Charpy) on the impact testing machine and find the impact strength.To determine the hardness of the given specimen using Brinell/Rockwell/Vicker testing machine.	15x2
	Total No. of Hours	**30**

SET/SH/BT/C207. CHEMISTRY LAB		
Module	**Content**	**No. of Hrs.**
Module 1	1. To determine Saponification value of given oil sample. 2. To determine the ferrous content in the supplied sample of iron ore by titrimetric analysis against standard $K_2Cr_2O_7$ solution using $K_3Fe(CN)_6$ as external indicator. 3. To determine the chloride content in supplied water sample using Mohr's method. 4. To determine acid value of given oil sample. 5. To determine the total hardness of water sample by EDTA titration. 6. To find chemical oxygen demand of a waste water sample using Potassium Dichromate. 7. Estimation of iron in plain carbon steel by redox titration. 8. Estimation of copper in brass by titration method. 9. Estimation of Zinc in brass by titration method. 10. Analysis of a coal sample by proximate analysis method.	15x2
	Total No. of Hours	**30**

SET/CS/BT/C208. COMPUTER PROGRAMMING LAB		
Module	**Content**	**No. of Hrs.**
Module 1	This lab shall have minimum 25 programs in C. There shall be minimum two programs per module as taught in theory. Programming shall follow logic/algorithm and flowchart wherever applicable. Exercises shall also enhance analytical and debugging abilities.	14x2
	Total No. of Hours	**28**

SET/ME/BT/S209. ENGINEERING WORKSHOP		
Module	**Content**	**No. of Hrs.**
Module 1	Mechanical Engineering covering, the following trades for experiments (with a minimum of two exercises under each trade) - Carpentry, Fitting, Tin-Smithy and Development of jobs carried out and soldering, Black Smithy, House Wiring, Foundry (Molding only), Plumbing.	16X2
Module 2	Power tools in Construction, Wood working, Electrical and Mechanical Engineering practices.	8x2
	Total No. of Hours	**48**

Semester III

S.No.	Subject Code	Course Title	L	T	P	T.A	C.T.	TOT	ESE.	SUB. TOTAL	Credit
1	SET/SH/BT/C301	Mathematics-III	3	1	-	10	20	30	70	100	3
2	SET/ME/BT/C302	Strength of Materials	3	1	-	10	20	30	70	100	3
3	SET/ME/BT/C303	Fluid Mechanics	3	1	-	10	20	30	70	100	3
4	SET/ME/BT/C304	Engineering Thermodynamics	3	1	-	10	20	30	70	100	3
5	SET/ME/BT/C305	Material Science	3	1	-	10	20	30	70	100	3
6	SET/ME/BT/C306	Fluid Mechanics Lab	-	-	2	30	-	30	70	100	1
7	SET/ME/BT/C307	Material Science & Testing Lab.	-	-	2	30	-	30	70	100	1
8	SET/ME/BT/C308	Machine Drawing & Auto-CAD Lab	-	-	4	30	-	30	70	100	2
9	SET/ME/BT/S309	*****Electrical Machines Lab	-	-	4	30	-	30	70	100	2
Total			15	5	12	170	100	270	630	900	21

***Skill Enhancement Course.**

SET/SH/BT/C 301. MATHEMATICS- III		
Module Name	**Contents**	**No. of Hrs.**
Ordinary Differential Equations	ODE of 2nd order with constant coefficients both homogeneous and non-homogeneous types with applications to electrical and mechanical systems. Difference equations and their solutions by Z transform. Series solutions of ODE of 2nd orders with variable coefficients with special emphasis to the differential equations of Legendre, Bessel and Chebyser. Legendre's polynomials, Chabyshev polynomials and Bessel's functions and their properties.	**10**
Integral Transforms	Fourier transform and integral Hankel transforms and Hilbert transforms and their properties, some simple applications.	**10**
Partial Differential Equations	Linear PDE with constant coefficients of 2nd order and their classifications. PDE of parabolic, elliptic and hyperbolic type with illustrative examples. Separation of variables method for solving PDE, such as two dimensional heat equations, wave equations and Laplace equations.	**10**
Functions of a Complex Variable	Analytic functions, Cauchy Riemann equations, harmonic functions line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula derivatives of analytic function, Liouvilles theorem, fundamental theorem of algebraic representation of a function by power series, Taylor's & Laurant series, poles & singularity of zeros. Residue theorem, conformal mapping, linear fractional transformation, special linear tranctional transformations.	**10**
	Total No. of Hours	**40**

Textbooks

1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers
2. H K Das, "Advanced Engineering Mathematics", S Chand
3. Erwin Kreyszig, "Advanced Engineering Mathematics"

SET/ME/BT/C 302. STRENGTH OF MATERIALS		
Module Name	**Contents**	**No. of Hrs.**
Stress & Strain	Simple Stresses and strains – Elastic constants – Relationship between elastic constants – Stress Strain Diagram – Ultimate Stress – Yield Stress – Deformation of axially loaded member – Composite Bars – Thermal Stresses – State of Stress in two dimensions – Stresses on inclined planes – Principal Stresses and Principal Planes – Maximum shear stress – Mohr's circle method for 2D systems.	**12**
Bending and Shear Stresses in Beams	Introduction, pure bending theory, Assumptions, derivation of bending equation, modulus of rupture, section modulus, flexural rigidity. Expression for transverse shear stress in beams, Bending and shear stress distribution diagrams for circular, rectangular, 'I', and 'T' sections. Shear center (only concept)	
Shear Force and Bending Moment Diagram & Deflection of Beams	Shear Force and bending moment diagram for statically indeterminate beam, Review of pure Bending. Direct and shear stresses in beams due to transverse and axial loads, composite beams Elastic curve – Governing differential equation – Double integration method – Macaulay's method – Area moment method – conjugate beam method for computation of slope and deflection of determinant beams	**8**
Torsion & Springs	Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – combined bending moment and torsion of shafts – Power transmitted to shaft – Shaft in series and parallel. Open and closed coiled helical springs under the action of axial load and/or couple. Flat spiral springs- derivation of formula for strain energy, maximum stress and rotation. Leaf spring deflection and bending stresses.	**8**
Columns and Struts	Introduction, short and long columns. Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory. Rankine-Gordon's formula for columns.	**8**
	Total No. of Hours	**44**

Text books

1. Mechanics of Materials by Bear Jhonston.
2. Strength of Materials by Timoshenko and & Youngs.
3. Strength of Materials by Ryder

References

1. S. C. Crandall, N. C. Dahl, and T. J. Lardner, An Introduction to the Mechanics of Solids, McGraw Hill.
2. Fundamentals of Strength of Materials, Nag, Wiley India
3. E. P. Popov, Engineering Mechanics of Solids, Prentice Hall.

SET/ME/BT/C 303. FLUID MECHANICS		
Module Name	**Contents**	**No. of Hrs.**
Introduction & Fluid Statics	Introduction: Continuum, Force, Stress, Strain, Solids vs. fluids, Types of fluids, Fluids Properties, Newton's Law of Viscosity, Stokes' Theorem, Compressibility & vapor pressure. Fundamental Concepts: Fluid Flow definition (Eulerian vs. Langrangian), System vs. Control Volume, Reynold's Transport Theorem. Fluid Statics: Hydrostatic law, Pascal's law, Pressure at a point, Total Pressure, Centre of Pressure, Pressure on a plane (Horizontal, Vertical & Inclined) & Curved Surface, Buoyancy & stability of floating & submerged bodies, Meta-centric height.	**8**
Dynamics of Fluid Flow	Fluid Kinematics: Types of flow (steady vs. unsteady, uniform vs. non-uniform, laminar vs. turbulent, One Two & Three dimensional, compressible vs. incompressible, rotational vs. irrotational), Stream lines, path lines, streak lines, velocity components, convective, local & total acceleration, velocity potential, stream function, Continuity equation in Cartesian co-ordinates. Fluid Dynamics: Introduction to Navier-Stokes's equation, Euler's equation of motion along a stream line, Bernoulli's equation, Application of Bernoulli's equation to Pitot tube, Venturimeter, Orifices, Orifices meter, Triangular & Rectangular Notches.	**8**
Dimensional Analysis & Laminar Flow	Dimensions of physical quantities, Dimensional homogeneity, Buckingham's Pi theorem, Important dimensionless numbers & their significance, Model analysis (Reynold, Froude & Mach). Laminar Flow: Definition, Relation between pressure & shear stresses, Laminar flow through round pipe, fixed parallel plates.	**8**
Boundary Layer Analysis	Development of Boundary layer on a flat plate, Laminar & Turbulent Boundary Layers, Laminar sub layer, Separation of boundary layer & Method of Controlling, Flow around Immersed Bodies, Lift & Drag, Classification of Drag, Flow around circular cylinder & Aerofoil, Development of lift on Aerofoil.	**8**
Flow through Pipes	Total energy line, Hydraulic grade line, Energy losses through pipe, Darchy-Weisbach equation, Minor losses on pipes, pipes in series & parallel, Siphons, Transmission of power, Turbulent flow, Velocity distribution	**8**
	Total hours	**40**

Text Books

1. S. Gupta, Fluid Mechanics and Hydraulic Machines, Pearson Publishers.
2. F. White, Fluid Mechanics, Tata-McGraw Hill publishers.
3. R. Fox and A. McDonald, Fluid Mechanics, John Wiley Publishers

References Books

1. Cengel and Cimbala, Fluid Mechanics, Tata-McGraw Hill Publishers.
2. J. Douglas, J. Gasiorek, J. Swaffield, and L. Jack, Fluid Mechanics, Pearson Publishers.
3. C. Ojha, P. Bernstein and P. Chandramouli, Fluid Mechanics and Machinery, Oxford University Press.

SET/ME/BT/C 304. ENGINEERING THERMODYNAMICS		
Module Name	**Contents**	**No. of Hrs.**
Availability and Irreversibility	Available energy, available energy referred to a cycle, quality of energy, maximum work in a reversible process, reversible work by an open system exchanging heat only with surroundings, useful work, dead state, availability, availability in a chemical reaction, irreversibility and Gouy- Stodala Theorem, availability or energy balance, second law efficiency, comments on energy, Helmholtz and Gibb's function. Problems	6
Thermodynamic Relations, Equilibrium and Third law	Mathematical conditions for exact differential, Maxwell's equation, Tds equations, difference in heat capacities, ratio of heat capacities, energy equation, Clausius-Clapeyron equation, evaluation of thermodynamic properties from an equation of state, general thermodynamic considerations on an equation of state, mixtures of variable composition, conditions of equilibrium of a heterogeneous system, Gibbs phase rule, Joule-Kelvin effect, Joule-Thompson coefficient and Inversion curve.	8
Power cycles	Review of all power cycles, Carnot Cycle, Rankine Cycle, Otto Cycle, Diesel Cycle, Dual Cycle, Brayton Cycle, Stirling Cycle, Ericsson Cycle, Bell Coleman Cycle, Lenoir Cycle	8
Boilers	Purpose of steam generators, Classification of boilers, Fire tube and water tube boilers, Mountings and accessories, description of Lancashire, Locomotive, Babcock Wilcox boilers, draught and design of natural draught chimney, artificial draught, mechanical draught, efficiency of boiler and heat balance. Problems	10
Introduction to Vapor Power Cycles	Introduction: Components of Steam Power System, Carnot Cycle, Rankine Cycle, Modified Rankine Cycle, p-v , h-s and T-s diagram for Rankine and Modified Rankine Cycle, Reheat Cycle, Superheat Cycle, Regenerative Cycle, Reheat Cycle, reheat factor, binary vapor and supercritical cycles, co-generation, Mollier"s diagram, use of steam table, Problems	8
Total No. of Hours		**40**

Text Books

1. Fundamentals of Thermodynamics by Sonntag, Wiley India
2. Yunus Cengel, Thermodynamics an Engineering Approach, Fourth Edition, Mc Graw Hill
3. Y V C Rao, An Introduction To Thermodynamics, Universities Press .

References Books

1. Engineering Thermodynamics by Jones and Dugans, PHI Learning Pvt. Ltd.
2. Fundamentals of Thermodynamics by Sonntag, Wiley India
3. Fundamentals of Classical Thermodynamics by Van Wylen, John Wiley.
4. Gas Turbine Theory & Practice, by Cohen & Rogers, Addison Weslay. Longman Ltd.

SET/ME/BT/C 305. MATERIAL SCIENCE		
Module Name	**Contents**	**No. of Hrs.**
Introduction and Crystallography	Introduction: Historical perspective, importance of materials, Brief review of modern & atomic concepts in Physics and Chemistry. Atomic models, Periodic table, Chemical bonding. Crystallography and Imperfections: Concept of unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density, Miller indices, X-ray crystallography techniques, Imperfections, Defects & Dislocations in solids.	**8**
Phase Diagram and Equilibrium Diagram	Mechanical properties and Testing: Stress strain diagram, Ductile & brittle material, Stress vs. Strength, Toughness, Hardness, Fracture, Fatigue and Creep. Testing's such as Strength tastings, Hardness testing, Impact tastings, Fatigue testing Creep testing, Non-destructive testing (NDT). Phase Diagram and Equilibrium Diagram: Unary and Binary diagrams, Phase rules. Types of equilibrium diagrams: Solid solution type, eutectic type and combination type, Iron-carbon equilibrium diagram.	**8**
Heat Treatment	Ferrous materials: Brief introduction of iron and steel making furnaces, various types of carbon steels, alloy steels and cast irons its properties and uses. Heat Treatment: Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams. Non-Ferrous metals and alloys: Non-ferrous metals such as Cu, Al, Zn, Cr, Ni etc. and its applications.	**8**
Magnetic properties and Electric properties	Magnetic properties: Concept of magnetism - Dia, para, Ferro Hysteresis. Soft and hard magnetic materials, Magnetic storages. Electric properties: Energy band concept of conductor, insulator and semi-conductor, Intrinsic & extrinsic semi-conductors. p-n junction and transistors.	**8**
Ceramics and Smart Materials	Ceramics: Structure types and properties and applications of ceramics, Mechanical/Electrical behavior and processing of Ceramics. Plastics: Various types of polymers/plastics and its applications, Mechanical behavior and processing of plastics, Future of plastics. Other Materials: Brief description of other material such as optical and thermal materials concrete, Composite Materials and its uses, Brief introduction to Smart materials & Nano-materials and their potential applications.	**8**
	Total No. of Hours	**40**

Text Books:
1. Van Vlack - Elements of Material Science & Engineering John Wiley & Sons.
2. V. Raghvan - Material Science, Prentice Hall

References:
1. Callister/Balasubramaniam – Callister˝s Material Science & Engineering Wiley India.
2. Chawla, Composite Materials, Taylor & Francis

SET/ME/BT/C 306. FLUID MECHANICS LAB
1. To determine the coefficient of impact for vanes. 2. To determine coefficient of discharge of an orifice meter. 3. To determine the coefficient of discharge of Notch (V and Rectangular types). 4. To determine the friction factor for the pipes. 5. To determine the coefficient of discharge of venture meter. 6. To determine the coefficient of discharge, contraction & velocity of an orifice. 7. To verify the Bernoulli's Theorem. 8. To find critical Reynolds number for a pipe flow. 9. To determine the meta-centric height of a floating body. 10. To determine the minor losses due to sudden enlargement, sudden contraction and bends. 11. To show the velocity and pressure variation with radius in a forced vertex flow. 12. To verify the momentum equation. **Note: Student has to perform 8 experiments**

SET/ME/BT/C 307. MATERIAL SCIENCE & TESTING LAB

Material Science Lab Experiments:

1. Making a plastic mould for small metallic specimen.
2. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
3. Grain size determination of a given specimen.
4. Comparative study of microstructures of different given specimens (mild steel, gray cast iron, brass, copper etc.
5. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison hardness before and after.
6. Faradays law of electrolysis experiment.
7. Study of corrosion and its effects.
8. Study of microstructure of welded component and HAZ, Macro and Micro Examination.
9. Suitable experiment on Magnetic/ Electrical/ Electronic materials.

Testing Lab Experiments:

1. To perform Tensile Test on Mild-steel specimen and draw stress strain curve.
2. To perform Izod, Charpy Impact test on standard specimen.
3. To perform Brinell, Rockwell, Vicker Hardness Test on standard specimen.
4. To calculate Torsional Rigidity.
5. To calculate Fatigue Test on Fatigue Testing Machine
6. To calculate Modulus of Elasticity by Non Destructive Testing.
7. Detection of cracks by Ultrasonic Testing Machine.
8. Detection of cracks by Dye Penetration Technique.
9. Creep testing on creep testing machine.
10. To Draw SFD and BMD for a simple supported beam under point and distributed load.

Note: Student has to perform 5-5 experiments from both labs.

SET/ME/BT/C 308. MACHINE DRAWING & AUTO CAD LAB

Orthographic Projections (One Drawing Sheet)

Principle of first angle and third angle projection, drawing of machine elements in first angle projection, selection of views, sectional views.

Screwed fasteners (Two Drawing Sheets)

Thread nomenclature, Forms of thread, Thread series, designation, Representation of threads, Bolted joints, locking arrangement of nuts.

Keys and Cotters and Pin joint (One Drawing Sheet)

Types of keys, Cotter joint or Knuckle joint

Shaft Couplings (One Drawing Sheet)

Introduction, Rigid coupling or Flexible coupling

Riveted joints (One Drawing Sheet)

Introduction, rivets and riveting, Types of rivet heads, Types of riveted joints, Boiler joint.

Assembly Drawing (One Drawing Sheet)

Introduction, Engine parts-stuffing box, cross head

Computer Aided Drafting

Introduction, input, output devices, introduction to software like AutoCAD, Pro-E, basic commands and development of 2D and 3D drawings of simple part

SET/ME/BT/C309. *ELECTRICAL MACHINES LAB

1. Open circuit characteristic of DC Shunt Generator.
2. Load test on DC Shunt Generator.
3. Speed control of DC Shunt Motor.
4. Brake test on DC Shunt Motor.
5. Brake test on DC Series Motor.
6. Regulation characteristic of three - phase Alternator.
7. Open circuit and short circuit tests on Single - phase Transformer.
8. Load test on Single - phase Transformer
9. Load test on three - phase Induction Motor.
10. Brake test on Single - phase Induction Motor.
11. 'V' curves of Synchronous Motor.

***Skill Enhancement Course.**

Semester IV

S.No.	Subject Code	Course Title	L	T	P	T.A	C.T.	TOT	ESE.	SUB. TOTAL	Credit
1	SET/ME/BT/C401	Kinematics of Machines	3	1	-	10	20	30	70	100	3
2	SET/ME/BT/C402	Manufacturing Technology-I	3	1	-	10	20	30	70	100	3
3	SET/ME/BT/C403	Measurement, Metrology & Control	3	1	-	10	20	30	70	100	3
4	SET/ME/BT/C404	Applied Thermodynamics	3	1	-	10	20	30	70	100	3
5	SET/ME/BT/C405	Advance Strength of Materials	3	1	-	10	20	30	70	100	3
6	SET/ME/BT/C406	Manufacturing Technology Lab.	-	-	2	30	-	30	70	100	1
7	SET/ME/BT/C407	Measurement, Metrology & Control Lab.	-	-	2	30	-	30	70	100	1
8	SET/ME/BT/C408	Applied Thermodynamics Lab.	-	-	4	30	-	30	70	100	2
9	SET/ME/BT/S409	*****AutoCAD 3D and ANSYS Lab.	-	-	4	30	-	30	70	100	2
Total			15	5	12	170	100	270	630	900	21

***Skill Enhancement Course.**

SET/ME/BT/C 401. KINEMATICS OF MACHINE		
Module Name	**Contents**	**No. of Hrs.**
Introduction & Velocity in Mechanisms	Links-types, Kinematics pairs-classification, Constraints-types, Degree of Freedom, Grubler's equation, linkage mechanisms, inversions of four bar linkage, slider crank chain and double slider crank chain. Velocity of point in mechanism, relative velocity method, instantaneous point in mechanism, Kennedy's theorem, instantaneous center method	**8**
Acceleration in Mechanisms & Mechanisms with Lower Pairs	Acceleration diagram, Coriolis component of acceleration, Klein's construction for Slider Crank and Four Bar mechanism, Analytic method for slider crank mechanism. Pantograph, Exact straight line motion mechanisms- Peaucellier's, Hart and Scott Russell mechanisms, Approximate straight line motion mechanisms Grasshopper, Watt and Tchebicheff mechanisms.	**8**
Kinematics Synthesis of Planar Linkages	Movability of four bar linkages, Grashoff's law, graphical methods of synthesis – Two and Three position synthesis of four bar and slider crank mechanisms, Analytical method- Freudenstein's equation for function generation (three position)	**8**
Cams and Follower	Cams and Followers - Classification & terminology, Cam profile by graphical methods for uniform velocity, simple harmonic motion and parabolic motion of followers.	**8**
Gears	Classification & terminology, law of gearing, tooth forms, interference, under cutting, minimum number of teeth on gear and pinion to avoid interference, simple, compound and planetary gear trains	**8**
	Total No. of Hours	**40**
Text Books 1. Theory of machines and mechanisms-Ghosh & Mallik, East-West Press 2.Theory of machines and mechanisms- S. S. Ratan, Tata Mc-Graw Hill		
References: 1.Kinematics, Dynamics and Design of Machinery, 2ed, w/CD, Waldron, Wiley India		

SET/ME/BT/C402 MANUFACTURING TECHNOLOGY		
Module Name	**Contents**	**No. of Hrs.**
Machining Operations	Lathe: Principle, types, operations, Shaper, Slotter, Planer, Milling: Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required. Drilling and Boring : Drilling, Boring, reaming tools. Geometry of twist drills.	6
Metal Cutting and Machine Tool	Metal Cutting- Mechanics of metal cutting, Geometry of tool and nomenclature, ASA system Orthogonal vs. oblique cutting. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Economics of metal cutting.	10
Casting Processes	Basic principle of casting, Types of patterns and allowances. Types and properties of moulding sand. Elements of mould and design considerations, Gating, system, Solidification of casting, Sand casting, defects & remedies and inspection. Die Casting, Centrifugal casting. Investment casting, CO2 casting and Stir casting .	8
Forming Processes	Introduction, plastic flow of metals, flow-stress curve, plastic deformation, yield criteria, work hardening, recrystallization, Hot working vs. cold working, Rolling, , defects in rolled products. Extrusion: Introduction, direct, indirect, impact extrusion, defects and their application in industries. types of forging, forging operations, Design considerations and defects in forging and applications, sheet metal operations like ,Blanking, Piercing, punching, drawing, deep drawing and embossing,	10
Grinding and Metal Joining Process	Grinding & super finishing-Grinding: Grinding wheels, abrasive, cutting action. Grinding wheel specification, Grinding wheel wear – attritions wear, fracture wears. Dressing and Truing. Surface and Cylindrical grinding. Centerless grinding. Super finishing: Honing, lapping, and polishing. Welding principle, electrodes, processes. Gas welding process and equipment. Arc welding: TIG & MIG, Resistance Welding- Spot and seam welding, Welding defects.	10
Total No. of Hrs		**42**

Text Books

1. Modern Machining Processes by P.C. Pandey & H.S. Shan.
2. Manufacturing Technology Metal Cutting & Machine Tools by PN Rao, TMH.
3. Manufacturing Process by Sontosh Bhatnagar, BSP Hyderabad.
4. Manufacturing Technology by Kalpak Jian, PHI.
5. Materials and processes in Manufacturing., Degarmo,Wiley India

Reference Books

1. Manufacturing science by Degarmo, Wiley India
2. Fundamentals of Modern Manufacturing, Groover, Wiley India.

SET/ME/BT/C 403. MEASUREMENTS, METROLOGY AND CONTROL		
Module Name	**Contents**	**No. of Hrs.**
Mechanical Measurements	Introduction: Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error. Sensors and Transducers: Types of sensors, types of transducers and their characteristics.	8
Measuring Devices	Measurement of pressure: Gravitational, directing acting, elastic and indirect type pressure transducers, Measurement of very low pressures. Strain measurement: Types of strain gauges and their working, calibration. Measurements of force and torque: Different types of load cells, elastic transducers, pneumatic & hydraulic systems. Temperature measurement: Thermometers, bimetallic thermocouples, thermistors. Vibration: Seismic instruments, vibration pick-ups and decibel meters, vibrometers accelerometers.	8
Metrology	Metrology: Standards of linear measurement, line and end standards. Limit fits and tolerances. Interchangeability and standardization. Linear and angular measurements devices and systems Comparators, Limit gauges classification, Taylor's Principle of Gauge Design.	8
Interferometer & Surface Texture	Measurement of geometric forms like straightness, flatness, roundness. Tool maker's microscope, profile project autocollimator. Interferometer: principle and use of interferometry, optical flat. Measurement of screw threads and gears. Surface texture: quantitative evaluation of surface roughness and its measurement.	8
Automatic Controls	Types of control systems ; Typical Block Diagram : Performance Analysis; Applications – Machine Tool Control, Boiler Control, Engine Governing, Aerospace Control, Active Vibration Control; Representation of Processes & Control Elements – Mathematical Modeling. Block Diagram Representation, Representation of Systems or Processes, Comparison Elements; Representation of Feedback Control systems – Block Diagram & Transfer Function Representation, Representation of a Temperature, Control System, Signal Flow Graphs, Problems. **Types of Controllers :** Introduction : Types of Control Action; Hydraulic Controllers; Electronic Controllers; Pneumatic Controllers; Problems.	8
	Total No. of Hrs	**40**

Reference Books:

1. B.C. Kuo , "Automatic Control System" Wiley India.
2. Doeblein E.O., "Measurement Systems, Application Design", McGraw Hill.

Text Book:

1. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House.
2. Nagrath & Gopal, "Control System Engineering", 4th Edition, New age International.

SET/ME/BT/C404. APPLIED THERMODYNAMICS		
Module Name	**Contents**	**No. of Hrs.**
Steam Engines & Steam Nozzles	Steam Engine: Working of steam engine, single acting and double acting steam engine, , ideal and actual indicator diagram, mean effective pressure, diagram factor, mechanical & thermal efficiency of steam engine.Steam Nozzles: Function of steam nozzles, shape of nozzles for subsonic and supersonic flow of steam, Steady state energy equation, continuity equation, nozzle efficiency, critical pressure ratio for max. Discharge, Problems.	**8**
Steam Turbines	Steam Turbine: Classification of steam turbine, impulse turbine, working principle, compounding of impulse turbine, velocity diagram, power output and efficiency of a single stage impulse turbine, reaction turbine, working principle, degree of reaction, velocity diagram, power output and efficiency, governing of steam turbines, problem.	**8**
Steam Condensers & Fuel and Fuel Combustion	Steam Condensers: Classification of condensers, sources of air leakage in condensers, effect of air leakage in condenser, vacuum efficiency, condenser efficiency, air pumps, cooling water calculation, and problem. Fuel and Combustion: Classification of fuels – solid, liquid and gaseous fuels, calorific values of fuels, stochiometric air fuel ratio, excess air requirement, analysis of exhaust gases, problem.	**10**
Compressors & Gas Power Cycles	Introduction to Centrifugal, Axial Flow Compressors, Reciprocating Compressors; Combustion Chambers; Simple gas turbine cycle – single and twin shaft arrangements, intercooling, reheating, regeneration, closed cycles, optimal performance of various cycles, combined gas and steam cycles;; Problems	**8**
Jet Propulsion	Jet Propulsion: turbojet, turboprop, turbofan, ramjet, thrust and propulsive efficiency; Rocket Propulsion; Direct Energy Conversion: thermionic and thermoelectric converters, photovoltaic generators, MHD generators, fuel cells.	**6**
Total no. of Hours		**40**

Text Books & References :

1. Thermodynamics and Heat Engines Vol II – R. Yadav, Central Publishing House
2. Thermal Engineering - P.L.Balaney Khanna Publisher.
3. Heat Engineering – V.P.Vasandani and D.S.Kumar, Metropolitan Book Co. Pvt. Ltd.

SET/ME/BT/C405. ADVANCE STRENGTH OF MATERIALS		
Module Name	**Contents**	**No. of Hrs.**
Stress, Principal Stresses, Strain Energy	Review of 2D stress system, 3D Stress: Three-dimensional stress and strain, Stress tensor, stress invariants, Strain Tensor, Equilibrium Equations, St. Vernants principle, generalized hooks law, Theories of elastic failure. Mohr circle for 3D stress and strain system.	10
Energy Principles & Indeterminate Beams	Introduction to strain energy, energy of dilation and distortion. Resilience, stress due to suddenly applied loads. Castigliano's and Maxwell's theorem of reciprocal deflection Concept of Analysis – Propped cantilever and fixed beams – fixed end moments and reactions –sinking and rotation of supports – Theorem of three moments – analysis of continuous beams –shear force and bending moment diagrams	09
Thin & Thick Cylinders & Spheres	Calculation of Hoop stress, longitudinal stress in a cylinder, effects of joints, change in diameter, length and internal volume. Principal stresses in sphere, change in diameter and internal volume. Derivation of Lame's equations, calculation of radial, longitudinal and hoop stresses and strains due to internal pressure in thick cylinders, compound cylinders, hub shrunk on solid shafts, shrinkage allowance and shrinkage stress.	06
Bending of Curved Beams	Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression	08
Rotational Discs & Unsymmetrical Bending	Rotating Disc and Cylinders: Rotational stresses in discs and rims of uniform thickness; discs of uniform Strength, long cylinder. Unsymmetrical Bending and Shear Centre: Properties of beam cross-section, Principal Axes, Determination of Principal Axes, stress and deflection in unsymmetrical bending, shear centre and Importance of shear centre.	08
		41

Text books

1. Mechanics of Materials by Bear Jhonston.
2. Strength of Materials by Timoshenko and & Youngs.
3. Strength of Materials by Ryder

References

1. S. C. Crandall, N. C. Dahl, and T. J. Lardner, An Introduction to the Mechanics of Solids, McGraw Hill.
2. Fundamentals of Strength of Materials, Nag, Wiley India
3. E. P. Popov, Engineering Mechanics of Solids, Prentice Hall.

SET/ME/BT/C406. MANUFACTURING TECHNOLOGY LAB

List of Experiments:

1. Bolt (thread) making on Lathe machine.
2. Tool grinding (to provide tool angles) on tool-grinder machine.
3. Gear cutting on Milling machine.
4. Finishing of a surface on surface-grinding machine.
5. Drilling holes on drilling machine and study of twist-drill.
6. Study of different types of tools and its angles & materials.
7. Gas welding experiment.
8. Arc welding experiment.
9. Resistance welding experiment.
10. Soldering & Brazing experiment.
11. Design of pattern for a desired casting (containing hole).
12. Pattern making.
13. Making a mould (with core) and casting.
14. Sand testing (at least one such as grain fineness number determination).
15. Forging: hand forging processes.
16. Forging: power hammer study & operation.
17. Tube bending with the use of sand and on tube bending m/c.
18. Press work experiment such as blanking/piercing, washer, making etc.
19. Wire drawing/extrusion on soft material.
20. Rolling-experiment.

Note: At least fifteen experiments should be performed from the above list.

SET/ME/BT/C 407. MEASUREMENT, METROLOGY & CONTROL LAB

List of Experiments:

1. Study & working of simple measuring instruments- Vernier calipers, Micrometer, Tachometer.
2. Measurement of effective diameter of a screw thread using 3 wire methods.
3. Measurement of angle using Sine bar & slip gauges.
4. Study of limit gauges.
5. Study & angular measurement using level protector.
6. Adjustment of spark plug gap using feeler gauges.
7. Study of dial indicator & its constructional details.
8. Use of dial indicator to check a shape run use.
9. Study and understanding of limits, fits & tolerances.
10. Study of Pressure & Temperature measuring equipment.
11. Strain gauge measurement.
12. Speed measurement using stroboscope.
13. Flow measurement experiment.
14. Vibration/work measuring experiment.
15. Experiment on Dynamometers.

Note: At least eight experiments (Four of Measurement and remaining four for the Metrology & control) should be performed from the above list.

SET/ME/BT/C 408. APPLIED THERMODYNAMICS LAB

List of Experiments:

1. To study low pressure boilers and their accessories and mountings.
2. To study high pressure boilers and their accessories and mountings.
3. To prepare heat balance sheet for given boiler.
4. To study the working of impulse and reaction steam turbines.
5. To find dryness fraction of steam by separating and throttling calorimeter.
6. To find power output & efficiency of a steam turbine.
7. To find the condenser efficiencies.
8. To study cooling tower and find its efficiency.
9. To find calorific value of a sample of fuel using Bomb calorimeter.
10. Calibration of Thermometers and pressure gauges.

SET/ME/BT/S409. *AUTOCAD 3D AND ANSYS

List of Experiments:

Isometric Drawings by CAD :Drawings of following on computer: Cone, Cylinder, Isometric view of objects
3D Modelling: 3D modelling, Transformations, scaling, rotation, translation
Various Programmes on ANSYS.

***Skill Enhancement Course.**

Semester V

S.No.	Subject Code	Course Title	L	T	P	T.A	C.T.	TOT	ESE.	SUB. TOTAL	Credit
1	SET/ME/BT/C501	Machine Design-I	3	1	-	10	20	30	70	100	3
2	SET/ME/BT/C502	Dynamics of Machines	3	1	-	10	20	30	70	100	3
3	SET/ME/BT/C503	Advance Manufacturing Process and Automation	3	1	-	10	20	30	70	100	3
4	SET/ME/BT/C504	Refrigeration & Air Conditioning	3	1	-	10	20	30	70	100	3
5	SET/ME/BT/C505	Mechanical Vibration	3	1	-	10	20	30	70	100	3
6	SET/ME/BT/S506	*Industrial Engineering & Management	2	1	-	10	20	30	70	100	2
7	SET/ME/BT/C507	Machine & Mechanism Lab.	-	-	2	30	-	30	70	100	1
8	SET/ME/BT/C508	Refrigeration & Air Conditioning Lab.	-	-	2	30	-	30	70	100	1
9	SET/ME/BT/C509	Mechanical Vibration lab	-	-	2	30	-	30	70	100	1
10	SET/ME/BT/C510	Seminar	-	-	2	30	-	30	70	100	1
Total			15	5	12	180	120	300	700	1000	21

***Skill Enhancement Course.**

SET/ME/BT/C501. MACHINE DESIGN - I		
Module Name	**Contents**	**No. of Hrs.**
Introduction	Introduction: Definition, Methods, standards in design & selection of preferred size. Selection of materials for static & fatigue loading, Materials for components subjected to creep, BIS system of designation of steels, steels, plastics & rubbers. AISI (American Iron & Steel Institution), ASTM rubber testing methods.	**8**
Design against static and fluctuating load	Design against static load: Modes of failure, Factor of safety, stress-strain relationship, principal stresses, theories of Failure. Design against fluctuating load: stress concentration, stress concentration factors, Fluctuating/alternating stresses, fatigue failure, endurance limit, design for finite & infinite life, Soderberg & Goodman criteria	**10**
Design of Joints, Shaft, Keys & Coupling	Design of Joints: Welded joint, screwed joints, eccentric loading of above joints, joint design for fatigue loading. Shaft, keys & coupling: Design against static and fatigue loads, strength & rigidity design, Selection of square & flat keys & splines, rigid & flexible couplings.	**10**
Design of Mechanical Springs and Power Screws	Mechanical springs: Design of Helical and leaf springs, against static & fatigue loading. Design analysis of Power Screws: Form of threads, square threads, trapezoidal threads, stresses in screw, design of screw jack.	**8**
Introduction to Product Development & Design Process	Introduction to Product Development & Design Process: Definition of Design, Design Process, Need Analysis, and Need based developments, Design by Evolution; Technology based developments, Examples case Studies, and brain-storming.	**8**
	Total no. of Hours	**44**

Text Books and References:

1. Design of Machine Elements: V.B. Bhandari, TMH.
2. Machine design : Sharma & Aggarwal, Katsons publications.
3. Mechanical Design, Theory and Methodology, Waldron, BSP, Hyderabad.
4. Machine Design : Maleev & Hartman.
5. Machine Design, Robert L Norton, Pearson .
6. Machine Design –U C Jindal, Pearson

SET/ME/BT/C 502. DYNAMICS OF MACHINE		
Module Name	**Contents**	**No. of Hrs.**
Force Analysis, Turning Moment & Fly Wheel	Static force analysis of linkages, Equivalent offset inertia force, Dynamic analysis of slider crank & Bar mechanism. Piston and Crank effort, Inertia, Torque, Turning moment diagrams, Fluctuation of energy, Flywheel.	**8**
Balancing of Machines	Static and dynamic balancing, balancing of rotating and reciprocating masses, Primary and secondary forces and couples.	**8**
Brakes and Dynamometers	Friction: Pivot and collar friction, Friction circle, Single plate, Multi-plate and Cone clutches, Michelle & Kingsbury thrust bearing and rolling contact bearing, Belts and pulleys, Flat and V belts, Design and selection. Brakes and Dynamometers (Mechanical Type): External and internal shoe brakes, Band and Block brakes, Hydraulic brakes, Absorption and Transmission dynamometers.	**8**
Governors	Governors: Dead weight and spring loaded governors, Sensitivity, Stability, Hunting, Isochronisms, Effort and Power, Friction and Insensitivity, Introduction to inertia governors.	**8**
Gyroscopic Motion	Gyroscopic Motion: Principles, Gyroscopic acceleration, gyroscopic couple and Reaction. Effect of Gyroscopic couple upon the stability of aeroplanes, ships, two & four wheelers.	**8**
	Total no. of Hours	**40**

Text books and References:

1. Theory of Machine: Thomas Bevan (Pearson) .
2. Theory of Machine: S.S.Ratan (TMH).
3. Kinematics, Dynamics & Design of Machinery-Waldron (Pearson).

SET/ME/BT/C503. ADVANCE MANUFACTURING PROCESS AND AUTOMATION.		
Module Name	**Contents**	**No. of Hrs.**
Unconventional Metal forming processes	Powder Metallurgy: Introduction, powder manufacture, powder mixing and blending, Powder metallurgy manufacturing process, need, advantage and applications. Manufacturing of Plastic components: Review of plastics, and its past, present & future uses, Injection moulding, Extrusion of plastic section, Welding of plastics. Future of plastic & its applications. Resins & Adhesives.	08
Non conventional Manufacturing Process	Introduction to non-conventional manufacturing processes their benefits and applications. Working principle of EDM, ECM, LBM, EBM, USM, AJM and WJM. Non-conventional welding- LBW, USW, EBW, Plasma arc welding and Explosive welding.	10
Automation	History of Automation, Reasons for automation, Disadvantages of automation, Automation systems, Types of automation – Fixed, Programmable and Flexible automation, Automation strategies. Automated Manufacturing Systems: Components, classification and overview of manufacturing Systems, Flexible Manufacturing Systems (FMS), Types of FMS, Applications and benefits of FMS.	10
Manufacturing System	Introduction, components and classification of manufacturing system, Fundamentals of Automated Production lines, Application of automated production lines, Automated assembly line: fundamental of manual assembly lines, alternative assembly system	8
Manufacturing Support System	Process planning, computer aided process planning, advance manufacturing planning, Production planning and control system: Aggregate production planning and the master production schedule, Material requirement planning, capacity planning	6
	Total No. of Hrs	**42**

References and Text Books

1. Automation , production system and computer integrated manufacturing, P. Groover, Pearson Education
2. Fundamentals of Modern Manufacturing, Groover, Wiley India.
3. Manufacturing Technology by Kalpak Jian, PHI.
4. Materials and processes in Manufacturing., Dedarmo,Wiley India.
5. Modern Machining Processes, P.C.Pandey and H.S.SHAN

SET/ME/BT/C 504. REFRIGERATION & AIR CONDITIONING		
Module Name	**Contents**	**No of Hrs**
Refrigeration	Introduction to refrigeration system, Methods of refrigeration, Carnot cycle, Reversed Carnot cycle, Carnot refrigerator and heat pump Unit of refrigeration, Air Refrigeration cycle: Open and closed air refrigeration cycles, Bell Coleman or Reversed Brayton air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Simple system, Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART) Steam jet refrigeration	**8**
Vapour Compression System	Modification in reversed Carnot cycle, Single stage system, Analysis of vapour compression cycle, use of T s and p h charts, Effect of change in suction and discharge pressures on C O P, Effect of sub cooling & superheating of suction vapour on performance of the cycle, Actual vapour compression cycle, Different configuration of multistage system, Cascade system Refrigerants: Classification, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants.	**8**
Vapour Absorption System	Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Ammonia – Water vapour absorption system, Lithium Bromide water vapour absorption system, Comparison	**8**
Air Conditioning	Introduction to air conditioning, Psychrometric properties and their definitions, Psychrometric chart, Different Psychrometric processes, Sensible heat factor (SHF), By pass factor , Apparatus dew point (ADP), Thermal analysis of human body, Design considerations, Effective temperature and comfort chart, Cooling and heating load calculations, Infiltration & ventilation, Internal heat gain, Grand Sensible heat factor (GSHF)	**8**
Refrigeration Equipment & Applications	Elementary knowledge of refrigeration & air conditioning equipments e g compressors, condensers, evaporators & expansion devices, Air washers, Cooling, towers & humidifying efficiency, Food preservation, cold storage, Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning .	**8**
	Total No. of Hrs	**40**

Text Books

1. Refrigeration and Air conditioning by C P Arora TMH
2 Refrigeration and Air conditioning by Arora & Domkundwar, Dhanpat Rai
3 Refrigeration and Air conditioning by stoecker & Jones

References Books

1 Refrigeration and Air conditioning by Roy J Dossat Pearson
2 Heating Ventilating and Air conditioning by Mcquiston

SET/ME/BT/C 505. MECHANICAL VIBRATIONS		
Module Name	**Contents**	**No of Hrs**
Introduction	Periodic motion, harmonic motion, superposition of simple harmonic motions, beats, Fourier Analysis Single Degree Freedom System: Free vibration, Natural frequency, Equivalent Systems, Energy method for determining natural frequency, Response to an initial disturbance Torsional vibrations, Damped vibrations Damping models – Structural, Coulomb and Viscous damping, Vibrations of system with viscous damping, Logarithmic decrement, Viscous dampers	8
Single Degree Freedom	Forced vibration, Harmonic Excitation with viscous damping, Steady state vibrations Forced vibrations with rotating and reciprocating unbalance, Support excitation Vibration isolation, Transmissibility, Vibration measuring instruments Displacement, Velocity, Acceleration and Frequency measuring instrument	8
Two Degree Freedom System	Introduction, Principal modes, Double pendulum, Torsional system with damping Coupled System, Undamped dynamic, vibration absorbers, Centrifugal pendulum absorber, Dry friction damper, Untuned viscous damper	8
Multidegree Freedom System	Exact Analysis Undamped free and forced vibrations of multidegree system Influence numbers, Reciprocal Theorem, Torsional vibration of multi rotor system, Vibration of geared system Principal coordinates, Continuous systems Longitudinal vibration of bars, Torsional vibrations of Circular shafts, Lateral vibration of beams	8
Numerical Analysis Techniques	Multidegree Freedom System: Numerical Analysis Rayleigh's, Dunkerley's, Holzer's and Stodola's methods, Rayleigh – Ritz method Critical Speed of Shafts: Shafts with one disc with and without damping, Multi disc shafts, Secondary critical speed	8
	Total no of Hrs	40

Text and Reference Books:

1 Mechanical Vibration –Magreb, Cengage India, New Delhi
2 Mechanical Vibration Practice with Basic Theory – V Rama Murthy – Narosa Publishers
3 Mechanical Vibrations – S S Rao, Pearson
4 Mechanical Vibration Palm, Wiley India, New Delhi

SET/SE/BT/S506. *INDUSTRIAL ENGINEERING & MANAGEMENT		
Module Name	**Contents**	**No. of Hrs.**
Definition of Industrial Engineering	Organization: Factory system, principles of organization, types of organization and their selection. Plant Layout: Site selection, types of layout, factors affecting layout, plant building, flexibility and expandability, materials handling devices.	**5**
Manufacturing Cost Analysis & Materials Management	Manufacturing Cost Analysis: Fixed & variable costs, Direct, indirect & overhead costs, & Job costing, Recovery of overheads, Standard costing, Cost control, Cost variance Analysis -Labor, material, overhead in volume, rate & efficiency, Break even Analysis, Marginal costing & contribution, Numerical. Materials Management : Definition and purpose of inventory, Inventory cost, Inventory systems- Single and multi period, EOQ, EBQ, Fixed order quantity models, Fixed time period models, Inventory control and Supply chain management (SCM)- ABC Inventory planning, Numerical.	**5**
Quality Management	Quality Management: Total quality management, Quality specifications and quality costs, ISO 9000 and ISO 14000, Six sigma- methodology and tools, Statistical quality control (SQC), Variables & Attributes- X, R, P & C - charts, Acceptance sampling, OC - curve,	**6**
Production Planning & Control (PPC)	Production Planning & Control (PPC) : Definition, objectives and importance of PPC, Functions and components of PPC, Demand management- Simple & Weighted moving average methods of forecasting, ,Aggregate planning techniques- Basic concepts, Master production schedule (MPS), Introduction to JIT, KANBAN, BIN Cards, CPM and PERT, Numerical.	**8**
Management Information Systems (MIS)	Management Information Systems (MIS): What is MIS? Importance of MIS, Organizational & information system structure, Role of MIS in decision making, Data flow diagram, Introduction to systems analysis & design, Organizing information systems. Product Design and Development: Various Approaches, Product life cycle.	**6**
	Total No. of Hours	**30**
Reference Books 1. Operations Management- Jacobs, Chase & Aquilano, Mc Graw Hill		
Text Books: 1. Operations Management - Schroeder, McGraw Hill ISE 2. Industrial & Systems Engineering - Turner, MIZE, CHASE, Prentice Hall 3. Production & Operations Management - Chary, TMH, New Delhi. 4. Industrial Engineering & Operations Management – S.K.Sharma & Savita Sharma, S.K.Kataria & Sons		

***Skill Enhancement Course.**

SET/ME/BT/C 507. MACHINE & MECHANISM LAB.

List of Experiments:

1. Study of simple linkers/models/mechanisms.
2. Experiment on Mechanism.
3. Design of 4-bar mechanism and its inversion.
4. Synthesis of Slider Crank Mechanism.
5. Study of straight line mechanism.
6. Experiment on Velocity acceleration.
7. Study of Ackerman-Devis Steering Mechanism.
8. Experiment on Gears (tooth profile, interference etc.).
9. Experiment on Gear trains.
10. Experiment on cams.
11. Experiment on Governors.
12. Experiment on critical speed of shaft (whirling of shaft).
13. Experiment on Gyroscope.
14. Experiment on Vibration (spring).
15. Balancing of Rotating and Reciprocating Masses.

Note: At least ten experiments should be performed from the above list. Five experiment from the first eight and five from the remaining list.

SET/ME/BT/C 508. REFRIGERATION & AIR CONDITIONING LAB.

List of Experiments:

1. Experiment on refrigeration test ring and calculation of various performance parameters.
2. To study different types of expansion devices used in refrigeration system.
3. To study different types of evaporators used in refrigeration systems.
4. To study basic components of air-conditioning system.
5. Experiment on air-conditioning test rig & calculation of various performance parameters.
6. To study air washers.
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compressor.
9. Experiment on Ice-plant.
10. Experiment on two stage Reciprocating compressor for determination of volumetric efficiency , PV diagram and effect of intercooling.
11. Study of Hermetically sealed compressor.
12. Experiment on Desert coolers.

Note: At least eight experiments should be performed from the above list.

SET/ME/BT/C 509. MECHANICALVIBRATIONS LAB.

List of Practicals

1To verify relation $T = 2\Pi\sqrt{(l/g)}$ for a simple pendulum.
2 To determine radius of gyration of compound pendulum.
3 To determine the radius of gyration of given bar by using bifilar suspension.
4 To determine natural frequency of a spring mass system.
5 Equivalent spring mass system.
6 To determine natural frequency of free torsional vibrations of single rotor system.
i. Horizontal rotor
ii. Vertical rotor
7 To verify the Dunkerley's rule.
8 Performing the experiment to find out damping co-efficient in case of free damped Torsional vibration
9 To conduct experiment of trifler suspension.
10 Harmonic excitation of cantilever beam using electro-dynamic shaker and determination of resonant frequencies.
11 Study of Vibration measuring instruments.
12 Perform study of the following using Virtual Lab http://www.vlab.co.in/
13 Forced Vibration of a Cantilever Beam with a Lumped Mass at Free End:
To calculate the natural frequency and damping ratio for forced vibration of a single DOF cantilever beam system, experimentally; and compare the results with theoretical values

SET/ME/BT/C 510. SEMINAR

Semester VI

S.No.	Code	Course Title	L	T	P	T.A	C.T.	Tot	Ese.	Sub. Total	Credit
1	SET/ME/BT/C601	Machine Design-II	3	1	-	10	20	30	70	100	3
2	SET/ME/BT/C602	IC Engines	3	1	-	10	20	30	70	100	3
3	SET/ME/BT/C603	Heat & Mass Transfer	3	1	-	10	20	30	70	100	3
4	SET/ME/BT/C604	Fluid Machinery	3	1	-	10	20	30	70	100	3
5	SET/ME/BT/C605	Operation Research Techniques	3	1	-	10	20	30	70	100	3
6	SET/BT/SE/S606	*Non Destructive Testing	2	1	-	10	20	30	70	100	2
7	SET/ME/BT/C607	Machine Design lab.	-	-	2	30	-	30	70	100	1
8	SET/ME/BT/C608	Heat & Mass Transfer Lab.	-	-	2	30	-	30	70	100	1
9	SET/ME/BT/C609	Fluid Machinery Lab	-	-	2	30	-	30	70	100	1
10	SET/ME/BT/C610	Mini Project	-	-	2	30	-	30	70	100	1
Total			17	5	8	200	100	300	700	1000	21

*Skill Enhancement Course.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, Tot – Total, ESE - End Semester Examination.

SET/ME/BT/C601 MACHINE DESIGN-II		
Module Name	**Contents**	No of Hrs
Gears	Spur Gears: Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involutes gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards. Helical Gears: Terminology, Proportions for helical gears, force analysis, Beam strength and wear strength of helical gears, herringbone gears, crossed helical gears, Design of helical gears Worm Gears: Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, force analysis, Strength and wear tooth load for worm gears, Design of worm gearing	**10**
Rolling Contact Bearing	Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Selection of rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing	**10**
Sliding Contact Bearing	Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing, Thrust bearing pivot and collar bearing, Hydrodynamic thrust bearing	**6**
Design of IC Engine Parts	Selection of type of IC engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin; Design of connecting rod; Design of centre crankshaft	**8**
Statistical Considerations in Design	Frequency Distribution, Characteristic of frequency curves, Probability distribution, Normal curve, Design and Natural Tolerances, reliability, Probabilistic approach to Design	**6**
	Total no of Hrs	**40**

References

1. Mechanical Engineering Design – Joseph E Shigely, McGraw Hill Publications.
2. Design of Machine Elements V B Bhandari, Tata McGraw Hill Co.
3. Machine design M F Spott, Prentice Hall India

Text books:

1 Machine Design Maleev and Hartman, CBS .
2. Machine design Black & Adams, Mc Graw Hill

SET/ME/BT/C602 I.C. ENGINES		
Module Name	**Contents**	**No. of Hrs.**
Introduction to I.C Engines and Fuels	Introduction to I.C Engines: Engine classification, Air standard cycles, Otto, Diesel, Dual Stirling and Ericsson cycles, Two and four stroke engines, SI and CI engines, Rotary engines, stratified charge engine, Fuel air cycles and their analysis, Actual cycles and their analysis, Valve timing diagram. Concept of variable compression ratio engines (VCR). Fuels: Fuels for SI and CI engine, important qualities of SI engine fuels, Rating of SI engine fuels, Important qualities of CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines	8
SI Engines	Carburetion, Mixture requirements, Carburetor types Theory of carburetor, MPFI, Combustion in SI engine, Flame speed, Ignition delay, abnormal combustion and it's control, combustion chamber design for SI engines. Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition, battery and its types, Charging and discharging of batteries.	8
CI Engines	Fuel injection in CI engines, Requirements, Types of injection systems, CRDI, Fuel pumps, Fuel injectors, Injection timings. Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamber design of CI engines. Scavenging in 2 Stroke engines, pollution and it's control	8
Lubrication & Supercharging	Engine Cooling: Different cooling systems, Cooling Towers, Radiators and cooling fans. Lubrication: Engine friction, Lubrication principal, Type of lubrication, Lubrication oils, Crankcase ventilation. Supercharging: Effect of altitude on power output, Types of supercharging. Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines	8
Compressors	Classification, Reciprocating compressors, Single and multi stage, Intercooling, Volumetric efficiency. Rotary compressors, Classification, Centrifugal compressor, Elementary theory, Vector Diagram efficiencies, Elementary analysis of axial compressors.	8
	Total No. of Hrs	**40**

Text Books

1. I.C. Engines by Ganeshan, TMH
2. I C Engines by Ferguson, Wiley India
3. A Course in International Combustion Engines, by Mathur & Sharma, Dhanpat Rai & Sons.

References Books

1. I.C Engine Analysis & Practice by E.F Obert.
2. I.C Engine, by R. Yadav, Central Publishing House, Allahabad.

SET/ME/BT/C603 HEAT & MASS TRANSFER		
Module Name	**Contents**	**No. of Hrs.**
Introduction to Heat Transfer and Conduction	Concepts of heat flows: conduction, convection and radiation, effect of temperature on thermal conductivity of materials, introduction to combined heat transfer. Conduction: One-dimensional general heat conduction equation in the Cartesian, cylindrical and spherical coordinates Initial and boundary conditions. Steady State One-dimensional Heat conduction: Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation, thermal resistance concept, Analogy between heat and electricity flow, thermal contact resistance, Overall heat transfer coefficient, critical thickness of insulation.	**8**
Fins and Transient Conduction	Fins: Types of fins, Fins of uniform cross-sectional area, errors of measurement of temperature in thermometer wells. Transient conduction: Transient heat conduction Lumped capacitance method, unsteady state heat conduction in one dimension only, Heisler charts.	**6**
Natural and Forced Convection	Forced Convection: Basic concepts, hydrodynamic boundary layer, thermal boundary layer, flow over a flat plate, flow across a single cylinder and a sphere, flow inside ducts, empirical heat transfer relations, relation between fluid friction and heat transfer, liquid metal heat transfer. Natural Convection: Physical mechanism of natural convection, buoyant force, and empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders and sphere.	**8**
Radiation	Thermal Radiation: Basic radiation concepts, radiation properties of surfaces, black body radiation laws, shape factor, black-body radiation exchange, Radiation exchange between non-blackbodies in an enclosure, Infinite parallel planes, radiation shields	**8**
Heat Exchanger and Introduction to Mass Transfer	Heat Exchanger: Types of heat exchangers, fouling factors, overall heat transfer coefficient, logarithmic mean temperature difference (LMTD) method, effectiveness-NTU method, compact heat exchangers. Condensation and Boiling: Introduction to condensation phenomena, heat transfer relations for laminar film condensation on vertical surfaces and on a horizontal tube, boiling modes: pool boiling curve, forced convective boiling. Mass Transfer: Introduction: Fick's law of diffusion, steady state equimolar counter diffusion, steady state diffusion though a stagnant gas film.	**10**
	Total No. of Hours	**40**

Text Books and References:

1. Elements of Heat transfer by Cengel, TMH.
2. Heat and mass transfer, M.Thirumaleswar, Pearson.
3. Fundamentals of Heat & Mass Transfer by Incropera Wiley India.
4. Heat & Mass Transfer by Khurmi, Schand,New Delhi

SET/ME/BT/C604 FLUID MACHINERY		
Module Name	**Contents**	**No of Hrs**
Impact of jet	Application of momentum and momentum equation to flow through hydraulic machinery, Euler's fundamental equation. Impact of jet: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat & curved), effect of inclination of jet with the surface Hydraulic Turbines: Classification of turbines, Impulse turbines, constructional details, velocity triangles, power and efficiency calculations, governing of Pelton wheel	**8**
Reaction Turbines	Fransis and Kaplan turbines, constructional details, velocity triangles, power and efficiency calculations, degree of reaction, draft tube, cavitation in turbines, principles of similarity, unit and specific quantities, specific speed, performance characteristics, selection of water turbines, bulb Turbines	**8**
Centrifugal Pumps	Classifications of centrifugal pumps, vector diagram, work done by impeller, efficiencies of centrifugal pumps, specific speed, model testing, cavitation and separation, performance characteristics Net positive suction head	**8**
Positive Displacement Pumps	Reciprocating pump theory, slip and coefficient of discharges, indicator diagram, effect and acceleration, work saved by fitting air vessels, comparison of centrifugal and reciprocating pumps, positive rotary pumps, Gear and Vane pumps, performance characteristics	**8**
Other Machines	Other Machines: Hydraulic accumulator, Intensifier, Hydraulic press, Lift and Cranes, theory of hydraulic coupling and torque converters, performance characteristics. Water Lifting Devices: Hydraulic ram, Jet pumps, Airlift pumps, water distribution systems	**8**
	Total no of Hrs	**40**

Text Books

1. Fluid Mechanics and Hydraulic Machines by S C Gupta, Pearson
2 Fundamentals of Fluid Mechanics by Munson, Pearson
3 Hydraulic Machines by Jagdish Lal, Metropolitan book co pvt ltd

References Books

1 Hydraulic Machines: Theory & Design, V P Vasandhani, Khanna Pub
2 Hydraulic Machines by R K Rajput, S Chand & co Ltd
3 Hydraulic Machines by D S Kumar

SET/ME/BT/C605 OPERATION RESEARCH TECHNIQUES		
Module Name	**Contents**	**No. of Hrs.**
Linear Programming	Basics of Operations Research, Introduction & Scope, Problem formulation, Graphical Method, Simplex methods, primal & dual problem sensitivity analysis.	9
Transportation & Assignment problems.	Formulation of games, two person-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), dominance property.Duality, PRIMAL-DUAL relations-its solution, shadow price, economic interpretation, dual-simplex, post-optimality & sensitivity analysis, problems.	9
Decision theory and Game Theory	Decision under various conditions. Game theory –Two person zero sum games– saddle points – pure and mixed strategies - dominance rule, Different Methods like Algebraic, Graphical, Liner Programming	7
Queuing Theory and PERT-CPM Techniques	Queuing system and their characteristics. The M/M/1 Queuing system, Steady state performance analyzing of M/M/ 1 and M/M/C queuing model. Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic models, prediction of date of completion, crashing of simple networks	6
Simulation and Decision Theory	Introduction, design of simulation, models & experiments, model validation, process generation, time flow mechanism, Monte Carlo methods- its applications in industries, problems. SIMON model types of decision making environment- certainty, risk, uncertainty, decision making with utilities, problems.	9
	Total no. of Hrs	**40**

References Book

1. Operations Research, Taha H. A, Pearson.
2. Introduction to operation research: Theory and Applications, Springer BSP, Hyderabad .
3. Operations Research,. S D Sharma , Kedarnath Ramnath

Text Books

1. Operations Research: Principles and practice: Ravindran, Phillips & Solberg, Wiley.
2. Operation Research, AM Natarajan, P.Balasubramani , ATamilaravari , Pearson

*SET/SE/BT/S606 NON DESTRUCTIVE TESTING	
Contents	**No of Hrs**
Introduction Scope and advantages of N D T some common NDT methods used since ages visual inspection, Ringing test, and chalk – test (oil whiting test) their effectiveness in detecting surface cracks, bond strength and surface defects	**6**
Common NDT Methods Dye penetrant tests – principle, scope, equipment and techniques Zyglo testing Magnetic Particle Tests Scope of test, Principle equipment and technique DC And AC magnetization, use of day and wet powders magnaglow testing Interpretations of results	**5**
Radiographic Methods: X ray radiography – principle, equipment and methodology Interpretation of radiographs, Limitations Gamma ray radiography Principle, equipment, source of radioactive material and technique Precautions against radiation hazards, Advantage over x ray radiography methods	**5**
Ultrasonic Testing Methods: Introduction Principle of Operation – piezoelectricity Ultrasonic probes, cathode ray oscilloscope techniques and advantages limitation and typical applications	**6**
Testing of castings, forgings & elements Application of NDT methods in inspection of castings, forgings and welded structures with illustrative examples Case studies Sample testing in the lab	**8**
Total no of hrs	**30**

Text and References Books

1. ASM Handbook Vol. 11, 8th Edition – Non-destructive Testing & Evaluation
2. Research Techniques in NDT Vol.3, R.S. Shah, Academic
3. Industrial Quality Control, Webstar
4. Bray, Don E. and Stanley, Roderic K., Nondestructive Evaluation: A Tool in Design, Manufacturing, and Service. Revised Edition 1997, CRC Press New York.

SET/ME/BT/C607MACHINE DESIGN LAB
List of Practicals:
1. Design & drawing of Cotter joint 2 Design & drawing of Knuckle joint 3 Design of machine components subjected to combined steady and variable loads 4 Design of eccentrically loaded riveted joint
5 Design of boiler riveted joint 6 Design of shaft for combined constant twisting and bending loads 7 Design of shaft subjected to fluctuating loads 8 Design and drawing of flanged type rigid coupling 9 Design and drawing of flexible coupling
10 Design and drawing of helical spring
11 Design and drawing of screw jack
12 Writing Computer programme for spur gears: Students are required to write computer program and validate it for the design of machine components done in theory subject.
13 Writing Computer programme for helical gears: Students are required to write computer program and validate it for the design of machine components done in theory subject
14 Writing Computer programme for rolling bearings
15 Writing Computer programme for Sliding bearings
Note: At least ten experiments (Five Experiment from the first ten and five computer program from the remaining five) should be performed from the above list

SET/ME/BT/C608 HEAT & MASS TRANSFER LAB
List of practicals: 1. Conduction - Composite wall experiment. 2. Conduction - Composite cylinder experiment. 3. Convection - Pool boiling experiment. 4. Convection - Experiment on heat transfer from tube-natural convection. 5. Convection - Heat Pipe experiment. 6. Convection - Heat transfer through fin-natural convection. 7. Convection - Heat transfer through tube/fin-forced convection. 8. Determination of Stephan Boltzmann Constant. 9. Determination of emissivity. 10. Heat exchanger - Parallel flow experiment. 11. Heat exchanger - Counter flow experiment. 12. Experiment on critical insulation thickness. 13. Conduction - Determination of thermal conductivity of fluids. 14. Conduction - Thermal Contact Resistance Effect. **Note: At least eight experiments should be performed from the above list.**

SET/ME/BT/C609 FLUID MACHINERY LAB
List of practicals: 1. Impact of Jet experiment. 2. Turbine experiment on Pelton wheel. 3. Turbine experiment on Francis turbine. 4. Turbine experiment on Kaplan turbine. 5. Experiment on reciprocating pump. 6. Experiment. on centrifugal pump. 7. Experiment on Hydraulic Jack/Press 8. Experiment on Hydraulic Brake 9. Experiment on Hydraulic Ram 10. Study through first visit of any pumping station/plant 11. Study through second visit of any pumping station/plant. 12. Any other suitable experiment/test rig such as comparison & performance of different types of pumps and turbines. **Note: At least eight experiments should be performed from the above list.**

Semester VII

S.No	Code	Course Title	L	T	P	T.A	C.T.	TOT	ESE	SUB. TOTAL	Credit
1	SET/ME/BT/C701	Automobile Engineering	3	1	-	10	20	30	70	100	3
2	SET/ME/BT/C702	CNC Machines and Programming	3	1	-	10	20	30	70	100	3
3	SET/ME/BT/C703	Finite Element Methods	3	1	-	10	20	30	70	100	3
4		Elective-I	3	1	-	10	20	30	70	100	3
5		Elective-II	3	1	-	10	20	30	70	100	3
6	SET/ME/BT/C710	Automobile & IC Engines Lab	-	-	-	30	-	30	70	100	1
7	SET/ME/BT/C711	CNC Machines and Programming Lab.	-	-	4	30	-	30	70	100	2
8	SET/ME/BT/C712	Project Preparation	-	-	4	30	-	30	70	100	2
9	SET/ME/BT/C713	Industrial Training Seminar	-	-	-	30	-	30	70	100	1
			15	5	8	170	100	270	630	900	21

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

	S. No.	Code	Course Title
Elective I	1	SET/ME/BT/E704	Unconventional Manufacturing Processes
	2	SET/ME/BT/E705	Advance Welding Technology
	3	SET/ME/BT/E706	Computer Integrated Manufacturing Systems
	4	SET/ME/BT/MOOCs	MOOCs (12 Weeks Duration)

	S. No.	Code	Course Title
Elective II	1	SET/IN/BT/E707	Product Design and Development
	2	SET/ME/BT/E708	Turbo Machines
	3	SET/ME/BT/E709	Mechatronics

SET/ME/BT/C701 AUTOMOBILE ENGINEERING		
Module Name	**Contents**	No of Hrs
Introduction & Fuel Supply System	Introduction: Classification of automobile, Parts of an automobile, Description of an automobile, performance of automobile, engine cycle energy balance, terms connected with I C Engines, Detonation, performance number, attractive efforts. Fuel Supply System: S I Engine: Carburetion & carburetors, Induction system, factor influencing carburetion, Mixture requirement, Distribution, Complete carburetor, theory of simple carburetor C I Engine: Functional requirements of an injection system, Fuel pump and fuel injector (Atomizer), Types of nozzles and fuel spray patterns, troubleshooting of a fuel system & carburetor, Turbo Charger (Function and benefits)	**7**
Engine Friction, Lubrication and Cooling System	Determination of engine friction, Lubrication, lubrication system, Crankcase ventilation, Necessity of engine cooling, Areas of heat flow in engines, gas temperature variation, heat transfer, temperature distribution & temp Profiles, cooling air and water requirements, cooling systems, troubleshooting of cooling system, gear box (Problems)	**7**
Chassis & Suspension	Chasis: Introduction Classification of chassis, Frame Suspension: Introduction, requirements of suspension system, springs, damper Wheels: Introduction, Requirement, types of wheels Tyres: Introduction, requirements, types of tyre, tyre construction cross ply, radial ply, belted bias, tyre materials tyre shape, tread patterns, tyre markings, tyre inflation pressure, causes of wear, factors affecting tyre life, wheel balancing, wheel alignments	**7**
Steering & Braking System	Steering & Gears: Purpose, function, requirements, general arrangements of steering systems, steering gears, steering ratio, reversibility, steering geometry, under steering, over steering, steering arms, Drag link, power steering, adjusting of steering geometry, steering troubleshooting Requirements Clutches Toque converters Over drive and free wheel, Universal joint Differential Gear Mechanism of Rear Axle Automatic transmission, Steering and Front Axle Castor Angle. Front Axle: Introduction, construction, types of front axles, stub axles Braking System: Necessity, functions, requirements, classification of brakes, Mechanical brakes, hydraulics brakes, power brakes, brake effectiveness, brake shoe holding down arrangements, brake tester, brake service, troubleshooting chart of hydraulic brakes system, air brakes & Brake shoes & drums	**10**
Ignition System	Automotive Electric System: Introduction, main parts of vehicles. Starting System: Introduction, battery, starting motor Ignition System: Introduction, purpose, requirements, coil ignition system, firing order, ignition timing, spark plugs, troubleshooting Charging System: Introduction Dynamo, alternators Lighting: introduction, main circuits, lighting system Maintenance system: Preventive maintenance, break down maintenance, and over hauling system	**9**
	Total no of Hrs	**40**

Text Books & Reference Books

1. Automotive Engineering Hietner
2. Automobile Engineering Kripal Singh
3. Automobile Engineering Narang
4. Automobile Engg K M Gupta

SET/ME/BT/C702 CNC MACHINES AND PROGRAMMING		
Module Name	**Contents**	No of Hrs
Module 1	Introduction:Definition of NC, Applications of NC ,Historical Developments in Automation, Classification of NC Systems, Comparison of NC and Conventional Machines, Advantages of NC	**8**
Module -II	NC Hardware:Architecture of NC Systems, Design Considerations, Mechanical Elements, Structure, Guideways and Slides, Guideway Elements, Transmission Systems, Spindle Unit, Coolant system, Lubrication System, Tool and work Changing Mechanisms, Electrical Elements, Drives, Sensors, Control Loops, Computing Elements/ Firmware, Interpolators	**8**
Module -III	NC Software:Introduction, Manual Part Programming, Computer-Assisted Part Programming, Language Based , Geometric Modeling Based, Automatic Part Program Generation,	**8**
Module -IV	CAPP Systems , 5 Axis Programming, Post-Processing, Programming Robots and CMMs. NC Simulation, Kinematic simulation, Volumetric simulation, Applications of Volumetric NC Simulation, Verification	**8**
Module - V	Advanced Topics:, Adaptive Control, Off-line adaptive control, Various optimisation criteria, Hardware Based AC, Software Based AC, Tooling and Instruments for NC Special Considerations in High Speed Cutting (HSC) and Die Sinking, Rapid Product Development, CAM, FMS, CIM	**8**
		40

Text Books & Reference Books

1. Krar S. and Gill A., CNC: Technology and Programming, McGraw Hill
2. Koren Y., Computer Control of Manufacturing Systems, Tata McGraw Hill
3. Pressman R.S. and Williams J.E., Numerical Control and Computer-Aided Manufacturing, John Wiley & Sons
4. Chang C.H. and Melkanoff M.A., ,NC Machine Programming and Software Design, Prentice-Hall

SET/ME/BT/C703 FINITE ELEMENT METHOD		
Module Name	**Contents**	**No. of Hrs.**
Introduction	Introduction to finite difference method and finite elements method, Advantages and limitations, Mathematical formulation of FEM, Different approaches in Finite Element Method – Direct Stiffness approach, simple examples, Variational approach, Elements of variational calculus - Euler Lagrange equation, Rayliegh Ritz method, Weighted Residual methods, Point Collocation method, Galarkin method - Steps involved in FEM.	8
Types of Elements Used	Interpolation Polynomials - Linear elements Shape function - Analysis of simply supported beam - Element and Global matrices - Two-dimensional elements, triangular and rectangular elements - Local and Natural Co-ordinate system.	8
Finite Element Formulation of Field Problems	1-D and 2-D heat transfer, fluid flow (incompressible and non viscous fluid) in ducts, Simple electrical and magnetic field problems. Simple Numerical examples.	8
Finite Element Formulation of Solid Mechanics Problems	1-D problem of shaft; Truss element analysis of pinned truss, Plane stress/strain problems, Axi symmetric problems, thin plate problems; Vibration of shafts & beams.	8
Numerical Methods in FEM	Evaluation of shape functions - One dimensional & triangular elements, Quadrilateral elements, Isoperimetric elements - Numerical Integration, Gauss Legendre quadrature - Solution of finite element equations – Gauss Elimination Method, Cholesky decomposition.	8
	Total no. of Hrs	**40**
References:- 1.The Finite Element Method O.C. Zienkiewicz and R.L. Taylor McGraw Hill 2. An Introduction to Finite Element Method J. N. Reddy McGraw Hill 3. Finite Element Procedure in Engineering Analysis K.J. Bathe McGraw Hill		
Text books:- 1. Finite Element Analysis C.S. Krishnamoorthy Tata McGraw Hill 2. Numerical Methods E Balagurusamy Tata McGraw Hill		

	SET/ME/BT/E704 UNCONVENTIONAL MANUFACTURING PROCESSES	
Module	**Contents**	**No of Hrs**
Introduction	Limitations of conventional manufacturing processes need of unconventional manufacturing processes & its classification and its future possibilities	8
Unconventional Machining Process	Principle and working and applications of unconventional machining process such as Electro Discharge machining, Electro chemical machining, ultrasonic machining, Abrasive jet machining etc Principle and working and application of unconventional machining processes such as Laser beam machining, Electron beam machining, Ultrasonic machining etc (these can also be used for welding)	8
Unconventional welding processes	Explosive welding, Cladding etc under water welding, Metalizing, Plasma are welding/cutting etc	8
Unconventional Forming processes	Principle, working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro Discharge forming, water hammer forming, explosive compaction etc	8
Electronic device Manufacturing	Brief description of Diffusion and Photo Lithography process for electronic device manufacturing	8
	Total no of Hrs	**40**
	Text and Reference Books: 1. Modern Machining Processes – P C Pandey 2. Unconventional Machining – V K Jain	

SET/ME/BT/E705 ADVANCE WELDING TECHNOLOGY		
Module Name	**Contents**	**No of Hrs**
Module 1	Solid state welding: classification of solid state welding processes, Adhesive bonding, advantages and applications.	**8**
Module 2	Friction welding: Friction welding process variables, welding of similar and dissimilar materials, Defective analysis of friction welded components, Friction welding of materials with inter layer. Friction stir welding: Processes parameters, tool geometry, welding of Aluminium alloys, Friction stir welding of Aluminum alloys and Magnesium alloys.	**8**
Module 3	Electron Beam welding (EBW): Electron Beam welding process parameters, atmospheric affect Defective analysis of Electron beam welds and Electron Beam welding dissimilar materials.	**10**
Module 4	Laser Beam welding (LBW): Laser Beam welding process parameters, atmospheric affect and Laser Beam welding of steels.	**6**
Module 5	Selection power source : Constant voltage and constant current power sources. Weldability of cast iron and steel : weldability studies of cast iron and steel,	**8**
	Total no of Hrs	**40**

Text and Reference Books:

1. Nadkarni S.V., Modern Welding Technology, Oxford IBH Publishers, 1996.
2. Parmar R. S., Welding Engineering and Technology, Khanna Publishers, 2005.
3. D. L. Olson, T. A. Siewert, Metal Hand Book, Vol 06, Welding, Brazing and Soldering, ASM International Hand book Metals Park, Ohio USA, 2008.

SET/ME/BT/E706 COMPUTER INTEGRATED MANUFACTURING	
Contents	**No. of Hrs.**
CAD/CAM Definition, Computer Technology-central processing unit (CPU), types of memory, input/output, the binary number system, computer programming languages. Automation- Types of automation, CIM, reasons for automating, automation strategies. Conventional Numerical Control: Basic components of NC system, the NC procedure, NC coordinate systems, NC motion control system, applications of numerical control, advantages and disadvantages of NC, computer controls in NC, problems with conventional NC, NC controller technology, computer numerical control, functions of CNC, advantages of CNC, Direct numerical control, components of a DNC system, functions of DNC, advantages of DNC.	8
NC Part Programming: Introduction, the punched tape in NC, tape coding and format, NC words, manual part programming, computer assisted part programming, the part programmer's job, the computer's job, NC part programming languages. The APT language: Geometry, statements, motion statements, post processor statements, auxiliary statements.	8
Robotics Technology : Joints and links, common robot configurations, work volume, drive systems, types of robot control, accuracy and repeatability, end effectors, sensors in robotics, applications of robots. Automated Material Handling & FMS: The material handling function, types of material handling equipment, conveyor systems, types of conveyors, automated guided vehicle systems, applications. FMS-Components, types of systems, applying FMS technology, FMS workstation, planning.	8
Computer Aided Quality Control: Introduction, terminology in Quality Control, the computer in QC, contact and non-contact inspection methods-optical and non-optical, and computer aided testing.	8
Computer Integrated Manufacturing Systems: Introduction, types, machine tools and related equipments, material handling systems, computer control systems, function of the computer in a CIMS, CIMS benefits.	8
Total no. of Hrs	**40**

Books and References:

1. Groover M.P - Automation, Production Systems and Computer Integrated Manufacturing. Prentice Hall.
2.Groover M.P, Zimmers E.W. - CAD/CAM, Prentice Hall of India.
3.Nanua Singh - Approach to Computer Integrated Design and Manufacturing, John Wiley

SET/IN/BT/E707. PRODUCT DESIGN AND DEVELOPMENT		
Module Name	**Content**	**No. of Hrs.**
Product Design	Introduction, Product Planning, Identifying Customer Needs, Project Selection, Concept Generation, Concept Testing, Concept Selection, Product Specification, Product Architecture, Industrial Design, Robust Design, Product Development Economics, Design for Manufacturing, Supply Chain Design, Intellectual Property, Design for Environment.	20
Product Development	Product Development Schedule, Customer base for customer needs survey, Project Proposal, Mission statement and customer needs, Concepts sketch and target specification, Preliminary concept selection, Drawings, plans and revised schedule, financial model and patent review Submission and Evaluation of Alpha prototype and test report, Beta prototype and customer evaluation, demonstration of working model.	2
Total No. of Hours		**40**
References	1. Karl T. Ulrich and Steven D. Eppinger, "Product Design and Development", 3rd Edition, Tata McGraw- Hill, 2003, ISBN 0-07-058513-X. 2. Kevin Otto and Kristin Wood, "Product Design", Pearson Education, 2003, ISBN: 8129702711.	

SET/ME/BT/E708 TURBO MACHINES		
Module Name	**Contents**	**No of Hrs**
Basic Concepts of Turbo machines	Definition, classification and stages of turbo machines, estimation of specific work for incompressible and compressible flow machines. Internal and external losses, various efficiencies, representation of specific work on T-s and h-s diagrams, velocity triangles - centrifugal and axial flow machine impellers, Euler's energy equation across the impeller as applicable to all machines, slip and its estimation, degree of reaction, blade angles and their effects, calculations considering slip.	**9**
Centrifugal Flow Machines	Fans - different impeller sizes, shapes, blade angles, speed and construction. Blade shape, blade number, simple design calculations, performance in series and parallel. Compressor - slip, inducers, designs without inducer but with inlet guide vanes (IGV). Simple problems with inducer and IGV's - blade angles, temperature rise and static pressure rise across the impeller. Vaned and vaneless diffuser and volute casing. Pump - system head, priming of pumps, net positive suction head, minimum starting speed and cavitations.	**9**
Axial Flow Fans And Compressors	Low pressure head rise fans - blade profile, lift and drag coefficients, their variation with incidence, expressions for energy transfer and pressure rise in terms of CL and CD, simple design calculations. Compressors - brief introduction to two-dimensional cascade and its application to design, flow deflection and stagnation pressure loss across blade rows, expression for pressure rise coefficient in terms of flow angles and loss coefficient. Design of impeller blades for free vortex and forced vortex. Simple design and performance calculations. Stall and surge phenomenon.	**9**
Hydraulic Turbines	Pelton turbine- impulse wheel, single jet and multiple jet units, velocity triangles at inlet and exit of buckets, performance calculations considering losses in the nozzle and buckets. Francis turbine - reaction, impeller shapes for different shape numbers/ heads, calculations on impeller dimensions, blade angles and performance using velocity triangles, draft tubes. Kaplan / Propeller Turbine - reaction, impeller (adjustable and fixed) blades and guide blades, calculation of performance using velocity triangles / blade angles at different radii for free vortex flow, its suitability for low heads.	**9**
Axial Flow Turbines	Degree of reaction - expression in terms of flow angles, importance of 50 percent reaction stage, effect on the velocity triangles, blade shape and efficiency. Comparison of impulse blades of constant thickness with blades thicker at the centre. Representation on h-s diagram, comparison of impulse and 50 percent reaction stages, stage efficiencies, velocity triangles, blade angle calculations. Steam turbines - condensing and non-condensing, partial admission at inlet, presence of moisture at the low pressure end of condensing turbines, problems associated with moisture - blade erosion and methods to reduce the bad effects.	**9**
	Total no of Hrs	**45**

Text and Reference Books:

1. Yahya.S.M, "Turbines, Fans and Compressors", 3rd edition, Tata McGraw Hill Publications.
2. Gopalakrishnan.G, Prithvi Raj.D, "Treatise on Turbomachines", 1st edition, Chennai, SciTech Publications.

SET/ME/BT/E709 MECHATRONICS		
Module Name	**Contents**	**No. of Hrs.**
Module-1	What is Mechatronics; A Measurement System with its constituent elements; Open and Closed Loop Systems; Sequential Controllers; Micro-processor Based Controllers, A review of Displacement, Position Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors / along with Performance Terminology; Selection of Sensors; Input Data by Switches; Signal Conditioning.	**10**
Module-2	Pneumatic, Hydraulic, Mechanical and Electrical Actuation Systems: Pneumatic and Hydraulic Systems; Directional Control Valves; Valve Symbols; Pressure Control Valves; Cylinder Sequencing; Process Control Valves; Rotary Actuators; Mechanical Systems – Types of Motion, Kinematic Chains, Cams, Gear Trains, Ratchet & Pawl, Belt & Chain Drives, Bearings, Mechanical Aspect of Motor Selection; Electrical Systems; Mechanical & Solid State Switches; Solenoids; D.C. & A.C. Motors; Stepper Motors; Problems. System Modeling and Performance: Engg. Systems; Rotational – Translational Systems; Electro-mechanical Systems; Hydraulic – Mechanical Systems; A review of modeling of First and Second Order Systems and Performance Measures.	**8**
Module-3	Closed Loop Controllers: Continuous and Discrete Processes – Lag, Steady State Error; Control Modes; Two- step Mode; Proportional Mode – Electronic Proportional Controllers; Derivative Control – Proportional plus Derivative Control; Integral Control - Proportional plus Integral Control; PID Controller – Operational Amplifier PID Circuits; Digital. Digital Logic and Programmable Logic Controllers : A Review of Number Systems & Logic Gates; Boolean Algebra; Kanaugh Maps; Sequential Logic, Programming; Timers, Internal Relays and Counters; Master & Jump Controls; Data Handling; Analogue Input/ Output; Selection of a PLC; Problems.	**6**
Module-4	Microprocessors and Input/Output Systems: Control; Microcomputer Structure; Micro- controllers; Applications; Programming Languages; Instruction Sets; Assembly Language Programs; Subroutines.	**6**
Module-5	Design and Mechatronics: Design Process; Traditional and Mechantronics Design; Possible Mechatronics design solutions for Timed Switch, Wind Screen Wiper Motion, Bath Room Scale, A Pick & Place Robot, design solutions for Timed Switch, Wind Screen Wiper Motion, Bath Room Scale, A Pick & Place Robot, Automatic Camera, Engine Management System & Bar Code Recorder.	**8**
	Total No of hrs	**40**

Text books and References

1. Mechatronics by W. Bolton, Published by Addition Wesley.
2. Mechatronics System Design – Devdas Shetty and Richard A. Kolx Brooks/ Cole
3. Introduction to Mechatronics and Measuring System : David G. Alciation and Michael B. Hits, TMH

SET/ME/BT/C710 AUTOMOBILE & IC ENGINE LAB
List of Experiment 1.Performance Analysis of Four stroke S I Engine. Determination of indicated and Brake thermal efficiency, specific fuel consumption at different loads and Energy Balance 2.Determination of Indicated Horse Power of I C Engine by Morse Test 3.Performance Analysis of Four stroke C I Engine. Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads and Energy Balance 4.To measure CO & Hydrocarbons in the exhaust of 2- stroke / 4-stroke petrol engine. 5.To find intensity of smoke from a single cylinder / multi-cylinder diesel engine. 6. To draw the scavenging characteristic curves of single cylinder petrol engine. 7.Study & experiment on Valve mechanism 8.Study & experiment on Gear Box 9.Study & experiment on Differential Gear Mechanism of Rear Axle 10.Study & experiment on Steering Mechanism 11.Study & experiment on Automobile Braking System 12.Study & experiment on Chassis and Suspension System **Note: At least ten experiments should be performed from the above list**

SET/ME/BT/C 711 CNC MACHINES AND PROGRAMMING LAB.	
Module Name	Related experiments.

SET/ME/BT/S712. INDUSTRIAL TRAINING SEMINAR	
Module Name	Content
	Student shall prepare a detailed report on her/his industrial training and deliver a seminar of 30 minutes.
Total No. of Hours	

Semester VIII

S. No.	Code	Course Title	L	T	P	T.A	C.T.	TOT	ESE.	Sub. Total	Credit
1	SET/ME/BT/C801	Power Plant Engineering	3	1	-	10	20	30	70	100	3
2	SET/ME/BT/C802	CAD/CAM and Robotics	3	1	-	10	20	30	70	100	3
3		Elective III	3	1	-	10	20	30	70	100	3
4		Elective IV	3	1	-	10	20	30	70	100	3
5	SET/ME/BT/C809	CAD/CAM and Robotics. Lab	-	-	2	30	0	30	70	100	1
6		Elective III Lab	0	-	2	30	-	30	70	100	1
		Elective IV Lab	-	-	2	30	-	30	70	100	1
7	SET/ME/BT/C816	Major Project	-	-	12	30	-	30	70	100	6
Total			15	4	18	160	80	240	560	800	21

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

	S. No.	**Code**	**Course Title**
Elective III	1	SET/ME/ BT/E803	Composite Material Technology
	2	SET/ME/ BT/E804	Optimization Techniques in Engineering
	3	SET/ME/ BT/E805	Experimental Stress Analysis
Elective III Lab	1	SET/ME/ BT/E810	Composite Material Technology Lab.
	2	SET/ME/ BT/E811	Optimization Techniques in Engineering Lab.
	3	SET/ME/ BT/E812	Experimental Stress Analysis Lab.

	S. No.	**Code**	**Course Title**
Elective IV	1	SET/ME/ BT/E806	Non-conventional Energy Resources and utilization
	2	SET/ME/ BT/E807	Nano Materials Processing and Properties
	3	SET/ME/ BT/E808	Flexible Manufacturing Systems
Elective IV Lab.	1	SET/ME/ BT/E813	Non-conventional Energy Resources and utilization Lab.
	2	SET/ME/ BT/E814	Nano Materials Processing and Properties Lab.
	3	SET/ME/ BT/E815	Flexible Manufacturing Systems Lab.

SET/ME/BT/C801 POWER PLANT ENGINEERING		
Module Name	**Contents**	**No of Hrs**
Introduction	Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion, calculations Variable Load problem Industrial production and power generation compared, ideal and realised load curves, terms and factors Effect of variable load on power plant operation, methods of meeting the variable load problem Power plant economics and selection Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit, depreciation and replacement, theory of rates Economics of plant selection, other considerations in plant selection	**8**
Steam power plant	Power plant boilers including critical and super critical boilers Fluidized bed boilers, boilers mountings and accessories General layout of steam power plant Different systems such as fuel handling system, pulverizes and coal burners, combustion system, draft, ash handling system, feed water treatment and condenser and cooling system, turbine auxiliary systems such as governing, feed heating, reheating , flange heating and gland leakage Operation and maintenance of steam power plant, heat balance and efficiency	**9**
Diesel power plant	General layout, performance of diesel engine, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance Gas turbine power plant Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants	**9**
Hydro electric station	Principles of working, applications, site selection, classification and arrangements, hydroelectric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems, micro and mini hydro power plant	**8**
Nuclear power plant	Principles of nuclear energy, basic components of nuclear reactions, nuclear power station Nuclear fuels in fission and fusion reactors, Types of nuclear reactors, Fissile and fertile materials, Neutron chain reaction in fission reactors, Neutron flux, Concept of criticality for bare homogeneous reactors, Coolants, moderators, Control and structural materials Heat generations and steady state temperature distribution in fuel elements, Heat removal	**9**
	Total no of Hrs	**43**

Text books:

1. Nuclear Reactor Engineering By S Glastone and A Sesonske .
2. Basic Nuclear Engineering, by K S Ram .
33. Introduction to Nuclear Engineering, by J R lamarsh.
4. "Power Plant Engineering" F T Morse, Affiliated East West Press Pvt Ltd, New Delhi/Madras

References Books

1 Power Plant Engineering, Mahesh Verma, Metropolitan Book Company Pvt Ltd.
2. Power Plant Technology, El Vakil, McGraw Hill.
3. Power Plant Engineering by P K Nag, Tata McGraw Hill.
4. Steam & Gas Turbines & Power Plant Engineering by R Yadav, Central Pub.

SET/ME/BT/C802 CAD/CAM AND ROBOTICS		
Module Name	**Contents**	**No of Hrs**
CAD Tools & Geometric Modeling	CAD Tools: Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, input and output devices Graphics standard, functional areas of CAD, Modeling and viewing, Review of C, C++, statements such as if else for while & switch, functions, pointernotations, structure & class, concept of OOPS .Geometric Modeling: Output primitives Bresenham's line drawing and Midpoint circle algorithms Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves hermite cubic splines Bezier curves B splines rational	**10**
Surface Modeling	Surface Modeling: Mathematical representation surfaces, Surface model, Surface entities surface representation, Parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder Parametric Representation of Synthetic Surface: Hermite Bicubic surface, Bezier surface, B Spline surface, COONs surface, Blending surface , Sculptured surface, Surface manipulation – Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D). Geometric Modeling 3D: Solid modeling, Solid Representation, Boundary Representation (B rep), Constructive Solid Geometry (CSG)	**10**
Collaborative Engineering	CAD/CAM Exchange: Evaluation of data – exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF. Collaborative Engineering: Collaborative Design, Principles, Approaches, Tools, Design Systems Introduction to CAD/CAE, Element of CAD, Concepts of integrated CAD/CAM, CAD Engineering applications, its importance & necessity Finite Element Methods: Introduction and Application of FEM, Stiffness Matrix/ Displacement Matrix, One/Two Dimensional bar & beam element (as spring system) analysis	**10**
NC Part Programming	NC Part Programming Manual (word address format) programming Examples Drilling and Milling.	**7**
System Devices & Interpolators	System Devices Introduction to DC motors, stepping motors, feed back devices such as encoder, counting devices, digital to analog converter and vice versa Interpolators Principle, Digital Differential Analysers Linear interpolator, circulator Interpolator and its software interpolator Control of NC Systems Open and closed loops Automatic control of closed loops with encoder & tachometers Speed variation of DC motor Adaptive control	**8**
	Total no of Hrs	**45**
Text Books **1.** CAD/CAM Theory and Practice – Ibrahim Zeid, TMH. 2. Computer Oriented Numerical Methods, Rajaraman, PHI		
References Books 1. CAD/CAM – Groover & Zimmers, Pearson		

SET/ME/ BT/E803 COMPOSITE MATERIAL TECHNOLOGY		
Module Name	**Contents**	**No of Hrs**
Introduction	Introduction, Current and potential advantages of fibre reinforced composites, Applications of composite materials, Military, civil, space, automotive and commercial applications	**8**
Fibers, matrices and fillers	Glass, Graphite, Aramid, Poletyhylene Fibers, Ceramic Fibres, Composite Fibres, SiC Whisker, SiC Particle, polymer matrix materials	**7**
Manufacturing of composites	Production Techniques of MMC, Polymer Matrix composites (PMCs), Production of(PMCs), Ceramic matrix Composites (CMCs), production techniques, Carbon-carbon Composites(CCCs), Production Chemical Vapor Deposition, Pyrolysis Using thermosets, Pyrolysis Using Thermoplastics	**10**
Mechanics of Composite Materials	Continuous Fibers, Iso stress condition, Iso strain condition, Stress Vs Strain Critical Volume fraction of fiber, Minimum volume fraction of fibre discontinuous fibers, Creep of composites Fatigue of Composites, Fracture Toughness Testing and inspection.	**6**
Recent developments	Self healing composites, Molecular Composites, Micro Composites, Nano Composites, Left Handed Composite Materials, Stiffer Than stiff Composites, Quick step process for PMCs, Biocomposites , Complex Composites.	**9**
	Total no of Hrs	**35**

Text and Reference Books:

1. Ronald F. Gibson, Principles of composite material mechanics, CRC Press, 2011.
2. Robert M Jones, Mechanics of Composite Materials, Taylor & Francis, 2000.
3. Lawrence E. Nielsen, Nielson, Paul Nielsen, Mechanical Properties of Polymers and Composites, Second Edition, CRC press, 2000

SET/ME/ BT/E804 OPTIMIZATION TECHNIQUES IN ENGINEERING		
Module Name	**Contents**	**No of Hrs**
Linear Programming	Introduction and formulation of models, Convexity, Simplex method, Big-M method, Two-phase method, Degeneracy, non-existent and unbounded solutions, revised simplex method,	**8**
Linear Part Programming	Duality in LPP, dual simplex method, sensitivity analysis, transportation and assignment problems, traveling salesman problem.	**7**
Nonlinear Programming:	Introduction and formulation of models, Classical optimization methods, equality and inequality constraints, Lagrange multipliers and Kuhn-Tucker conditions, quadratic forms, quadratic programming problem, Wolfe's method.	**10**
Dynamic Programming	Principle of optimality, recursive relations, solution of LPP	**6**
Integer Linear Programming	Gomory's cutting plane method, Branch and bound algorithm, Knapsack problem, linear 0-1 problem	**9**
	Total no of Hrs	**35**

Text and Reference Books:

1. Kanti Swarup, Man Mohan and P.K.Gupta, Introduction to Operations Research, S.Chand & Co., 2006
2. J.C.Pant, Introduction to Operatins Research, Jain Brothers, New Delhi, 2008.
3. N.S.Kambo : Mathematical Programming Techniques, East-West Pub., Delhi, 1991.

SET/ME/ BT/E805 EXPERIMENTAL STRESS ANALYSIS		
Module Name	**Contents**	**No of Hrs**
Basic concepts	The generalized basic systems – Definition – Stress at a point - Stress equation of equilibrium – Principal stress – Two dimensional stress systems – Strain and stress relations – Principal strain – Strain compatibility – Plane stress – Plane stress and strain problems – Photoelastic methods : Behaviour of light – Polarised light – Plane polariser – Wave plate – Conditioning of light by a series combination of linear polarizer and a wave plate – Arrangement of optical elements in polariscope . The stress optic law in two dimensions at normal incidence – Plane polariscope – Circular polariscope - Fringes – Moiré techniques – Photo elastic photography – Photo elastic model materials – Properties – Calibration methods – Analysis of photoelastic data – Isochromatics – Isoclinics – Compensation techniques - Application of photo elastic methods .	**15**
Electrical strain gauges	Definition of strain and its relation to experimental determination – Strain gauge – Types – Analysis – Strain sensitivity – Gauge construction – Temperature compensation – Rosette analysis – Rectangular Delta - Delta – Stress gauge – Strain gauge circuits – Wheatstone bridge – Null Balance recording instruments – Cathode Ray Oscilloscope.	**10**
Non Destructive Tests	Need , Types – Visual Examinations , penetrate tests, Hammer tests – Brittle coating techniques – Crack patterns – Types of coatings – Elementary ideas-Holographic non Destructive testing .	**10**
	Total no of hrs	**35**

Text and References Books

1. Photo elasticity - M.M.Frocht.
2. Experimental stress analysis – J.W.Dally and W.P.Railey.
3. Applied stress Analysis – Durelli and Philips.
4. Experimental stress analysis and Motion Measurement – R.C.Dove and B.H.Adams.
5. Moire Fringes Strain Analysis – Pericles Theocaries.

SET/ME/ BT/E806. NON-CONVENTIONAL ENERGY RESOURCES & UTILIZATION		
Module Name	**Contents**	**No. of Hrs.**
Energy resources and their utilization:	Indian and global energy sources, Energy exploited, Energy planning, Energy parameters (energy intensity, energy-GDP elasticity), Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation.	**8**
Solar energy	Solar thermal power and it's conversion, Solar collectors, Flat plate, Performance analysis of flat plate collector, Solar concentrating collectors, Types of concentrating collectors, Thermodynamic limits to concentration, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing. Solar thermal energy storage, Different systems, Solar pond. Applications, Water heating, Space heating & cooling, Solar distillation, solar pumping, solar cooking, Greenhouses, Solar power plants.	**8**
Biogas	Photosynthesis, Bio gas production, Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Producer gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications. Wind energy: Properties of wind, Availability of wind energy in India, wind velocity, Wind machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Wind energy farms, Economic issues, Recent development.	**8**
Electrochemical effects and fuel cells	Principle of operation of an acidic fuel cell, Reusable cells, Ideal fuel cells, Other types of fuel cells, Comparison between acidic and alkaline hydrogen-oxygen fuel cells, Efficiency and EMF of fuel cells, Operating characteristics of fuel cells, Advantages of fuel cell power plants, Future potential of fuel cells .	**8**
Tidal power	Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy, Limitations of tidal energy conversion systems. Hydrogen Energy: Properties of hydrogen in respect of its use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel, Development of hydrogen cartridge, Economics of hydrogen fuel and its use. Thermoelectric systems: Kelvin relations, power generation, Properties of thermoelectric materials, Fusion Plasma generators.	**8**
	Total no. of Hours	**40**

Text Books & References :

1. Bansal Keemann, Meliss," Renewable energy sources and conversion technology", Tata McGraw Hill.
2. Kothari D.P., "Renewable energy resources and emerging technologies", Prentice Hall of India Pvt. Ltd.
3. Ashok V. Desai, "Non conventional Energy", New Age International Publishers Ltd.

SET/ME/ BT/E807 NANOMATERIALS PROCESSING AND PREOPERTIES		
Module Name	**Contents**	**No of Hrs**
Introduction	Why nanoscale materials? Overview, definitions, and examples. Top-down and bottom-up approaches. Atoms, clusters and Nanomaterials Introduction, Melting point of Gold Nanocrystal, Vapour pressure of Nanocrystals.	**6**
Nanomaterials Synthesis and Processing	One Dimensional Nano-structures:Nano wires and nano rods, Spontaneous growth: Evaporation and condensation growth, vapor-liquid-solid growth, stress induced recrystallization. Template based synthesis: Electrochemical deposition, Electro-phoretic deposition. Electrospinning and Lithography. Two dimensional nano-structures: Fundamentals of film growth. Physical vapour Depostion(PVD): Ebvaporation molecular beam epitaxy (MBE), Sputtering, Comparison of Evaporation and sputtering. Chemical Vapour Deposition (CVD): Typical chemical reactions, Reaction kinetics, transportant phenomena, CVD methods, diamond films by CVD.	**10**
Thin films	Atomic layer deposition (ALD), Electrochemical deposition (ECD), Sol-Gel films. Special Nano Materials: Carbon fullerence and nano tubes: carbon Fullerness, formation, properties and applications. Carbon nano tubes: formation and applications.	**5**
Nanocomposites Synthesis and Processing	Introduction, Historical perspective, Different Synthesis methods of Nanocomposites-self Assembly or Bio-Mimetic processes, Film; Processing of Nanoparticles- Binding mechanisms in Nanoparticles, Dispersion of Nanoparticles.	**11**
Stabilization of Nanoparticles	Special nanostructured materials- Fullerenes- Magnetism and tunneling, Fullerenes films, other applications; Nanotubes- carbon Nanotubes; Onions-carbon onions, Porous silicon- Preparation methods. Characterization of Nanomaterials: SEM, TEM, X-ray Diffraction, Optical microscopy, EDS.	**8**
	Total no of hrs	**40**

Text and References Books

1. Gabor L. Hornyak, H.F Tibbals, Joydeep Dutta & John J Moore, Introduction to Nanoscience and Nanotechnology, CRC Press,
2. Ray F. Egerton , Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM , Springer.
3. Guozhong Cao, Nano structures and Nano materials: Synthesis, properties and applications - Imperial College press.

SET/ME/ BT/E808 FLEXIBLE MANUFACTURING SYSTEMS		
Module Name	**Contents**	**No of Hrs**
Module 1	Understanding of FMS: Evolution of Manufacturing Systems, Definition, objective and Need, Components, Merits, Demerits and Applications of FMS	**6**
Module 2	Processing stations: Machining Centers, Turning centers, CMM, Washing/ Deburring station, etc. Different Layouts and their Salient features . Material Handling System: An introduction, Conveyor, AGV, ASRS, Robots, etc. and their salient features.	**10**
Module 3	Management technology: Tool Management, Configuration planning and routing, Production Planning and Control, Scheduling and control	**10**
Module 4	Computer networks and control: Hardware, Software and database of FMS. Design of FMS: Performance Evaluation, Analytical model and Simulation model of FMS	**10**
Module 5	Case studies: Typical FMS problems from researches papers	**4**
	Total no of hrs	**40**

Text and References Books

1. Groover,M.P "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India Pvt.Ltd. New Delhi
2. Tempelmeier.H and Kuhn.H. "Flexible Manufacturing system: Decision support for design and operation", John Wiley and Sons
3. Maleki A. "Flexible Manufacturing Systems: the technology and management". Prentice Hall International.

SET/ME/BT/C809. CAD/CAM AND ROBOTICS LAB		
Module	**Content**	**No. of Hrs.**
Experiments	1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program. 2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program. 3. Design of machine component or other system experiment: Writing and Validation of computer program. Simulation and modeling by using ARENA software. 4. Understanding and use of any 3-D Modeling Software commands. 5. Pro/E/Idea etc. Experiment: Solid modeling of a machine component 6. Writing a small program for FEM for 2 spring system and validation of program or using a fem Package 7. Numerical differentiation or numerical integration experiment: Writing and validation of computer program. 8. To study the characteristic features of CNC machine 9. Part Programming (in word address format) experiment for turning operation(including operations such as grooving and threading) and running on CNC Machine. 10. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine 11. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine 12. Experiment on Robot and programs 13. Experiment on Transfer line/Material handling 14. Experiment on difference between ordinary and NC machine, study or Retrofitting 15. Experiment on study of system devices such as motors and feedback devices	15x2
	Total No. of Hours	**30**

SET/ME/BT/E810. COMPOSITE MATERIAL TECHNOLOGY LAB.		
Module	Content	**No. of Hrs.**
Module 1	Related experiments.	14x2
	Total No. of Hours	**28**

SET/ME/BT/E811. OPTIMIZATION TECHNIQUES IN ENGINEERING LAB.		
Module	**Content**	**No. of Hrs.**
Module 1	Related experiments.	14x2
	Total No. of Hours	**28**

SET/ME/BT/E812. EXPERIMENTAL STRESS ANALYSIS LAB.		
Module	**Content**	**No. of Hrs.**
Module 1	Related experiments.	14x2
	Total No. of Hours	**28**

SET/ME/BT/E813. NON-CONVENTIONAL ENERGY RESOURCES AND UTILIZATION LAB		
Module	**Content**	**No. of Hrs.**
Module 1	Related experiments.	14x2
	Total No. of Hours	**28**

SET/ME/BT/E814. NANO MATERIALS PROCESSING AND PROPERTIES LAB.		
Module	**Content**	**No. of Hrs.**
Module 1	Related experiments.	14x2
	Total No. of Hours	**28**

SET/ME/BT/E815. FLEXIBLE MANUFACTURING SYSTEMS LAB.		
Module	**Content**	**No. of Hrs.**
Module 1	Related experiments.	14x2
	Total No. of Hours	**28**

Appendix-I

Mandatory Induction Program for Mechanical Engineering Branch

3 weeks duration
▪ Physical activity ▪ Creative Arts ▪ Universal Human Values ▪ Literary ▪ Proficiency Modules ▪ Lectures by Eminent People ▪ Visits to local Areas ▪ Familiarization to Dept./Branch & Innovations

***Induction program for students to be offered right at the start of the first year.**

1. Induction Program:

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Precious little is done by most of the institutions, except for an orientation program lasting a couple of days.

We propose a 3-week long induction program for the UG students entering the institution, right at the start. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

Physical Activity:

This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 6 am for light physical exercise or yoga. There would also be games in the evening or at other suitable times according to the local climate. These would help develop team work. Each student should pick one game and learn it for three weeks. There could also be gardening or other suitably designed activity where labour yields fruits from nature.

Creative Arts:

Every student would chose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

Universal Human Values:

It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through dos and don'ts but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program. Besides

drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

Literary:

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

Proficiency Modules:

This period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

Lectures by Eminent People:

This period can be utilized for lectures by eminent people, say, once a week. It would give the students exposure to people who are socially active or in public life.

Visits to Local Area:

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

Familiarization to Dept. /Branch & Innovations:

The students should be told about different method of study compared to coaching that is needed at IITs. They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

Prof. Ashutosh Gupta Prof. M.M.S Rauthan Prof. N.S.Pawar Dr. Manoj Kumar Gupta

Prof. Y.P Raiwani
(Convener)
Dean, S.O.E.T