

SYLLABI OF CERTIFICATE & DIPLOMA MODULE (2+1) (TECHNOLOGY)



(Revised and approved by the 33rd Academic Council Meeting held on 4th December, 2021)



North Eastern Regional Institute of Science & Technology

[Deemed to be University u/s 3 of UGC Act, 1956]

[Under Ministry of Education, Govt. of India]

Nirjuli (Itanagar) :: Arunachal Pradesh - 791 109 :: www.nerist.ac.in

REVISED SYLLABUS

FOR

CERTIFICATE & DIPLOMA MODULE [2+1]

(Technology)



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PREFACE

The syllabi of U.G. Programmes have been revised and approved in the 33rd Academic Council Meeting held on 04.12.2021. The Academic Programme of NERIST in Technology Stream has been designed to consist of three modules, i.e., Certificate (2 years after Class 10), Diploma (1 additional year after Certificate, if Certificate CGPA is less than 6.5) and B.Tech. (4 year after Certificate with CGPA more than 6.5 or Class 12). In Applied Science Stream, four years B.Sc. Programme is offered in Forestry.

The syllabi for Certificate, Diploma [2+1] and Degree Programmes of NERIST are unique and innovative and have been prepared by the faculty members of the Institute appropriately incorporating the requirements of AICTE, UGC, and ICAR guidelines.

The following norms have been followed in presenting the structures and contents.

COURSE CODE:

Courses are denoted by codes comprising of two letters and five digits. The letters indicate the department which is offering the courses. Additionally, some specific letters are also used to denote specific cases, viz., ES for Engineering Sciences, ED for Extra-Curricular Activities and Discipline, MO for Open Elective courses to be taken from MOOC.

The five digits of the number used for denoting a course have the following descriptions:

- i. The first digit from the left stands for the module (1 for Certificate or Diploma, 2 for Degree).
- ii. The second digit from the left stands for the year.
- iii. The third digit 1 or 2 from the left stands for the odd or even semester respectively for the compulsory courses.
- iv. The third digit '0' from the left represents an elective course.
- v. The fourth and fifth digits from the left are used for course number of which 00 to 50 are reserved for theory courses or courses with more theory component and 51 to 99 are for practice courses which doesn't have any theory examination.

Besides the following course codes are specifically reserved:

MYS77 – Audit Course

MYS79 – Industrial Training

MYS88 – Extra-Curricular Activities and Discipline

MYS89 – Seminar

MYS99 – Project

“**M**” stands for Module, “**Y**” stands for Year, and “**S**” stands for Semester.

COURSE CREDIT:

Lecture/Tutorial: One hour per week per semester is equivalent to one credit. Extra tutorials, whenever applicable do not carry any credits.

Practice: Two hours per week per semester is equivalent to one credit. If the number of practice hour is an odd number, then the credits equivalent to the next higher even number of hours will be assigned. For example, 3 hours of practice will carry 2 credits, 5 hours carries 3 credits and so on.

UNITIZATION:

The courses have been unitized for five units. Each unit has been assigned specific number of contact hours, which has been fixed @ 14 contact hours per lecture credit of the course.

RECOMMENDED BOOKS:

Suggestions on the recommended books have been given at the end of each course, which may be supplemented by the Course Coordinator, if required.

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DEPARTMENT OF AGRICULTURAL ENGINEERING

Year I Semester I						
S.N.	Course Code	Course Title	L	T	P	Credit
1	HS11101	Remedial English – I	2	0	2	03
2	PH11101	Physics – I	3	0	2	04
3	CY11101	Chemistry – I	3	0	2	04
4	MA11101	Mathematics – I	3	1	0	04
5	ES11151	Engineering Drawing	0	0	6	03
6	ES11152	Workshop Practice	0	0	4	02
Total						20

Year I Semester II						
S.N.	Course Code	Course Title	L	T	P	Credit
1	HS11201	Remedial English – II	2	0	2	03
2	PH11201	Physics – II	3	0	2	04
3	CY11201	Chemistry – II	2	0	2	03
4	MA11201	Mathematics – II	3	1	0	04
5	ES11200	Basic Electrical and Electronics Engineering	3	0	2	04
6	ME11251	Mechanical Drawing	1	0	4	03
Total						21

Year II Semester III						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	MA12101	Mathematics – III	3	1	0	04
2.	ES12100	Basics of Computer and Programming	2	0	2	03
3.	AE12101	Basic Thermodynamics	2	1	0	03
4.	AE12102	Introduction to Surveying	2	0	2	03
5.	AE12103	Basic Food Engineering	2	0	2	03
6.	AE12104	Fundamentals of Machine Elements	3	0	0	03
7.	AE12105	Agronomy and Soil Science	2	1	0	03
Total						22

Year II Semester IV						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	ES12201	Technical Mechanics	3	1	0	04
2.	HS12201	Fundamentals of Entrepreneurship	3	0	0	03
3.	AE12201	Introduction to Tractor	1	0	2	02
4.	AE12202	Processing of Farm Produces	2	0	2	03
5.	AE12203	Basics of Fluid Mechanics	2	0	2	03
6.	AE12204	Basics of Pumps	2	0	0	02
7.	HS12277	Essence of Indian Traditional Knowledge (Audit)	2	0	0	00
8.	AE12279	Winter Internship	0	0	0	03
9.	ED12288	Extra-Curricular Activities and Discipline	0	0	0	02
Total						22

Year III Semester V						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	AE13101	Mechanics of Granular Materials	2	0	2	03
2.	AE13102	Post-Harvest Process Engineering	2	0	2	03
3.	AE13103	Farm Irrigation Systems	2	0	2	03
4.	AE13104	Farm Power	2	0	2	03
5.	AE13105	Agricultural Drainage	2	0	2	03
6.	AE130**	Programme Elective – I	*	*	*	03
7.	AE130**	Programme Elective – II	*	*	*	03
8.	**1304*	Open Elective – I	*	*	*	03
9.	AE13199	Project – I	0	0	2	01
Total						25

Year III Semester VI						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	AE13201	Hydrology and Soil Water Conservation	2	0	2	03
2.	AE13202	Agricultural Machinery	2	0	2	03
3.	AE13203	Farm Engines	2	1	0	03
4.	AE13204	Heat and Mass Transfer in Food Engineering	2	1	0	03
5.	AE130**	Programme Elective – III	*	*	*	03
6.	**1304*	Open Elective – II	*	*	*	03
7.	**1304*	Open Elective – III	*	*	*	03
8.	HS13277	Indian Constitution (Audit)	2	0	0	00
9.	AE13289	Seminar	0	0	2	01
10.	AE13299	Project – II	0	0	6	03
Total						25

LIST OF ELECTIVES

Programme Electives – I & II						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	AE13001	Agricultural Produce and Storage	2	0	2	03
2.	AE13002	Aquacultural Engineering	2	1	0	03
3.	AE13003	Food Safety and Standards	3	0	0	03
4.	AE13004	Hydraulic Systems	2	1	0	03
5.	AE13005	Land Grading and Earth Moving Machinery	2	0	2	03
6.	AE13006	Material Science and Engineering	2	1	0	03
7.	AE13007	Tea Science and Technology	2	1	0	03
8.	AE13008	Tractor Systems	2	0	2	03
9.	AE13009	Unit Operations in Food Engineering	2	1	0	03
10.	AE13010	Water Well and Pump Engineering	2	1	0	03

Programme Elective – III						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	AE13021	Alternate Energy Sources	2	1	0	03
2.	AE13022	Building Materials and Construction	2	1	0	03
3.	AE13023	Hydrological Processes	2	1	0	03
4.	AE13024	Micro-Irrigation Systems	2	0	2	03
5.	AE13025	Minor Irrigation	2	1	0	03
6.	AE13026	Processing of Dairy Products	2	0	2	03
7.	AE13027	Ravines Land Development	2	1	0	03

Open Elective – I						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	AE13041	Basics of Remote Sensing and GIS	2	1	0	03

Open Elective – II/III						
S. N.	Course Code	Course Title	L	T	P	Credit
2.	AE13042	Introduction to Computer Aided Design using Solidworks	0	0	5	03

COURSE CONTENT

AE12101 Basic Thermodynamics: 3 Credits (2-1-0)		
Unit I	Introduction to thermodynamic systems: open, closed and isolated. Zeroth law of thermodynamics. Measurement of temperature.	6 lectures
Unit II	Work and heat transfer: displacement work, indicator diagram, path and point function, specific heat and latent heat.	5 lectures
Unit III	First law of thermodynamics: introduction, specific heat, enthalpy. Concept of isochoric, adiabatic, isobaric and isothermal processes.	6 lectures
Unit IV	Second law of thermodynamics: Clausius' and Kelvin-Planck statements, reversibility and irreversibility. Introduction to entropy and enthalpy.	6 lectures
Unit V	Thermodynamic cycles: Otto cycle, Diesel cycle and dual cycle.	5 lectures
Books: <ol style="list-style-type: none"> 1. Engineering Thermodynamics, P.K. Nag, 2nd Ed., Tata McGraw Hill Pub. Co. Ltd. New Delhi, 1985. 2. Heat and Thermodynamics, M.W. Zimmansky and R.H. Dittman, International Edition, McGraw Hill Book Co., Auckland, 2000. 3. Introduction to Thermodynamics, Y.V.C. Rao, Wiley Eastern Ltd., New York, 1993. 4. Fundamentals of Classical Thermodynamics, G.J. Van Wyten, R.E. Sonntag and C. Borgnakke, 2nd Ed., Wiley Eastern Ltd., New York, 1998. 		

AE12102 Introduction to Surveying: 3 Credits (2-0-2)		
Unit I	Measurement of distance; concept of scale; principles and methods of chain surveying	8 lectures
Unit II	Principles and methods of compass surveying	6 lectures
Unit III	Principles and methods of plane table surveying	4 lectures
Unit IV	Principles of levelling, drawing contour maps	6 lectures
Unit V	Measurement of regular and irregular area and volume, estimation of earthwork	4 lectures
Books: <ol style="list-style-type: none"> 1. Surveying Vol. I, B.C. Punamia, Laxmi Publications, New Delhi, 2005. 2. Surveying Vol. I, S.K. Duggal, Tata McGraw-Hill, New Delhi, 1996. 3. Surveying and Levelling, N.N. Basak, Tata McGraw-Hill, New Delhi, 1994. 4. Surveying and Levelling Vol. I, T.P. Kanetkar and S.V. Kulkarni, Vidyarthi GrihaPrakashan, Pune, 2000. 5. Surveying, M. Das Saikia, B.M. Das, M.M. Das, PHI Learning, New Delhi, 2010. 		

AE12103 Basic Food Engineering: 3 Credits (2-0-2)		
Unit I	Introduction to heat transfer, fluid transfer and mass transfer in food processing.	6 lectures
Unit II	Principles of Food preservation and methods: physical and chemical methods of food preservation	5 lectures
Unit III	Thermal and non-thermal Food Preservation methods: Pasteurization, sterilization, UHT, canning. Irradiation, cooking and baking.	6 lectures
Unit IV	Evaporation, Drying and dehydration. Microwave and IR heating.	7 lectures
Unit V	Freezing and Refrigeration in food processing and their machineries.	4 lectures
Books: <ol style="list-style-type: none"> 1. Fundamentals of Food Process Engineering, R.T. Toledo, 2nd Ed., CBS Publishers and Distributors, New Delhi, 1997. 2. Unit Operations in Chemical Engineering, McCabe, Smith and Harriot, 5th Ed., McGraw Hill Book Co., New York, 1993. 3. Transport Processes and Unit Operations, C.J. Geankopolis, 3rd Ed., Prentice Hall of India, New Delhi, 1999. 4. Food Engineering Operations, Brennan, Butters Cowell and Lilley, 3rd Ed., Elsevier Applied Science, Amsterdam, 1990. 		

AE12104	Fundamentals of Machine Elements: 3 Credits (3-0-0)	
Unit I	Introduction to some engineering materials like MS, CI, Al, Cu etc. and their alloys, non-metallic engineering materials.	10 lectures
Unit II	Introduction to machine components like fasteners, bearing, coupling, spring, belt and chain drive, gear etc.	10 lectures
Unit III	Lubrication and lubricants: types, properties and grades. Additives used in lubricants. Seals and packing.	6 lectures
Unit IV	Heat treatment and material hardening techniques: annealing, normalizing, quenching, tempering etc.	8 lectures
Unit V	Introduction to preventive maintenance, defects and the corrective steps. Servicing and maintenance of mechanical, electrical, hydraulic and pneumatic systems.	8 lectures
Books:		
<ol style="list-style-type: none"> 1. Industrial Maintenance, H.P. Garg, S. Chand and Co., New Delhi, 1997. 2. Machine Operation and Maintenance manual, Escorts Tractor Limited, Bangalore. 3. Elements of Workshop Technology, Vol.-I, S.K. Hajra Choudhury, A.K. Hajra Choudhury and S.C. Bhattacharya, 10th Ed., Media Promoters and Publishers Pvt. Ltd., Mumbai, 1986. 		

AE12105	Agronomy and Soil Science: 3 Credits (2-1-0)	
Unit I	Definition of soil, Rocks and minerals. Soil formation and classification. Soil survey methods. Land use capability and mapping. Major soil types of India, soil texture, soil temperature and soil air.	9 lectures
Unit II	Soil colloids, cation and anion exchange in soils, soil reactions and buffering capacity. Soil humus and its formation, C:N ratio. Significance of macro and micro nutrients, Soil and water testing, Soil fertility management. Important fertilizers. Saline and alkali soils and their reclamations.	9 lectures
Unit III	Principles of tillage. Tillage and its characteristics. Weeds and their control, Fertilization and plant protection.	7 lectures
Unit IV	Classification of crop, cropping systems, mono, double and multiple cropping. Relay cropping and mixed cropping, crop rotation, Concept of dry farming.	8 lectures
Unit V	Cultivation practices of important field crops, improved varieties, seed rate, time and method of sowing, maturing. Effect of different weather parameters on crop growth and development.	9 lectures
Books:		
<ol style="list-style-type: none"> 1. Fundamentals of Soil Science, D. Henry, John Wiley and Sons, New York, 1990. 2. Soils, An introduction to Soils and Plant Growth, R.W. Miller and R.L. Donajue, Prentice Hall Inc., 1990. 3. Basic Concepts of Soil Science, A.K. Kolay, Wiley Eastern Ltd., New Delhi, 1993. 4. Fundamentals of Agronomy, G.C. De, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi, 1989. 		

AE12201	Introduction to Tractor: 2 Credits (1-0-2)	
Unit I	History of tractor, major tractor manufacturers in India, technical specifications of various types and models of tractors. Difference between automobile and tractor. Various hand and foot operated controls.	2 lectures
Unit II	Tractor engines: components of engine; fuel, cooling, lubrication, air intake and exhaust system. Engine troubles: causes and their remedies.	4 lectures
Unit III	Front axle and steering system: functions, mechanism and troubleshooting. Brake system: functions and mechanism.	3 lectures
Unit IV	Wheels and tyres: types and function. Causes of tyre wear. Spacing of wheels and arrangement. Wheel ballasting and methods of ballasting.	2 lectures
Unit V	Electrical system: components of electrical systems viz. battery, ignition switch, starting solenoid, self-starter motor, dynamo. Their functions, operation and maintenance.	3 lectures

Books:

1. Farm Tractor Maintenance and Repair, 4th Ed., S.C. Jain and C.R. Rai, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
2. Elements of Agricultural Engineering, 3rd Ed. J. Sahay, Agro Book Agency, Patna, 1992.

AE12202	Processing of Farm Produces: 3 Credits (2-0-2)	
Unit I	Cleaning, sorting, grading and sieving in food processing and their machinery.	5 lectures
Unit II	Size reduction in food processing: methods, law and their equipment's	5 lectures
Unit III	Material handling and transportation of food: conveyor and elevators	7 lectures
Unit IV	Fruits & vegetables processing machinery: steam jacket kettle, juicer, fruit mill or pulper.	5 lectures
Unit V	Dairy processing and machinery: reception of milk, straining, filtration, clarification, standardization, homogenization and Cream separation.	6 lectures

Books:

1. Fundamentals of Food Process Engineering, R.T. Toledo, 2nd Ed., CBS Publishers and Distributors, New Delhi, 1997.
2. Unit Operations in Chemical Engineering, McCabe, Smith and Harriot, 5th Ed., McGraw Hill Book Co., New York, 1993.
3. Transport Processes and Unit Operations, C.J. Geankopolis, 3rd Ed., Prentice Hall of India, New Delhi, 1999.
4. Food Engineering Operations, Brennan, Butters Cowell and Lilley, 3rd Ed., Elsevier Applied Science, Amsterdam, 1990.

AE12203	Basics of Fluid Mechanics: 3 Credits (2-0-2)	
Unit I	Basic Concepts and Definitions – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, viscosity, Newton law of viscosity; surface tension, capillarity, Bulk modulus of elasticity, compressibility.	4 lectures
Unit II	Fluid Statics - Fluid Pressure: Pressure at a point, Pascals law, Manometer, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.	4 lectures
Unit III	Fluid Kinematics –Classification of fluid flow: steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one-, two- and three-dimensional flows; streamline, path line, streak line and stream tube; stream function, velocity potential function, continuity equations.	7 lectures
Unit IV	Fluid Dynamics- Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation: venturimeter, orifice meter and pitot tube; laminar and turbulent flow in pipes, general equations for head loss.	8 lectures
Unit V	Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number.	5 lectures

Books:

1. Hydraulics and Fluid Mechanics, P.N. Modi and S.M. Seth, Standard Book House, NaiSarak, Delhi., 1999.
2. Fluid Mechanics & Hydraulic Machines, R.K. Bansal, Laxmi Publication Pvt.td., New Delhi, 2000.
3. A Text Book of Hydraulics, Fluid Mechanics and Hydraulic Machines, R.S. Khurmi, S. Chand and Company, New Delhi, 2000.
4. A Text Book of Fluid Mechanics and Hydraulic Machines in S.I Units. R.K. Rajput, S. Chand and Company.

AE12204 Basics of Pumps: 2 Credits (2-0-0)		
Unit I	Pump classification: dynamic and positive displacement pumps, pump selection, characteristics curves, priming, cavitation,	4 lectures
Unit II	Centrifugal pumps: Parts of a Centrifugal Pump, classification of centrifugal pump, impeller and its types, Affinity law, specific speed, discharge capacity of pump based on crop requirement, multistage pumps, accessories for centrifugal pump,	8 lectures
Unit III	Principle of operation, selection and installation of Turbine pump, submersible pump, propeller pump, mixed flow pump and jet pump	7 lectures
Unit IV	Principle of operation of injection pump and positive displacement pumps: Gear pump, vane pump, piston pump, lobe pump.	4 lectures
Unit V	Accessories for installation of different pump, friction losses in pumping system, basic operation and maintenance of pumps, basic economics of pumping system.	5 lectures
Books: 1. Water Wells and Pumps, A.M. Michael, S.D. Khepar and S.K. Sondhi, Tata McGraw Hill Publishing Co. Ltd. New Delhi. 2. Irrigation Theory and Practice, A.M. Michael, second revised and enlarged edition, Vikas Publishing House, New Delhi., 2008. 3. Principles of Agricultural Engineering, Vol. 2, A.M. Michael and T.P. Ojha, 3 rd edition, Jain Brothers, New Delhi, revised edition.		

AE13101 Mechanics of Granular Materials: 3 Credits (2-0-2)		
Unit I	Preliminary definitions and relationships, three phase system of soil, determination of index properties, classification of soils.	8 lectures
Unit II	Soil water: analysis of effective and neutral pressures under different hydraulic pressures at different points below the soil.	5 lectures
Unit III	Darcy's law, determination of permeability by laboratory and field methods, horizontal and vertical hydraulic conductivity and seepage analysis using flownet.	5 lectures
Unit IV	Stress distribution under point, line and circular load condition, compaction, consolidation and shear strength analysis using Mohr circle.	6 lectures
Unit V	Analysis of active and passive earth pressures on retaining wall, Rankine's theorem of earth pressure and bearing capacity of soils.	4 lectures
Books: 1. Soil Mechanics SI Version, T.W. Lambe and R.V. Whitman, Wiley Eastern Ltd., New Delhi, 1979. 2. Principles of Soil Mechanics and Foundation Engineering, V.N.S. Murthy, UBSPD, New Delhi, 2001. 3. Soil Mechanics and Foundations, B.C. Punia, Ashok Kumar Jain and Arun Kumar Jain, 13 th Ed., Laxmi Publications Pvt. Ltd., New Delhi, 1994. 4. Soil Engineering in Theory and Practice, Part-I, A. Singh and G.R. Chowdhury, CBS Publishers and Distributors, Delhi, 1994.		

AE13102 Post-Harvest Process Engineering: 3 Credits (2-0-2)		
Unit I	Importance of engineering properties of biological materials.	5 lectures
Unit II	Cleaning, sorting and grading operations; Screening: effectiveness of screening; Machineries for cleaning, sorting and grading.	5 lectures
Unit III	Drying utilities of agricultural produce: Psychrometric, theory of grain drying, drying methods, different types of grain dryers.	7 lectures
Unit IV	Milling of cereals, pulses and oilseeds: Milling of wheat, paddy and pulses; Parboiling of paddy; Processing of oilseed, oil extraction methods.	6 lectures
Unit V	Storage of agricultural produce: physiology of food grain during storage. Grain storage structure; Different types of storage structures; Aeration and fumigation.	5 lectures
Books: 1. Fundamentals of Food Process Engineering, R.T. Toledo, 2 nd Ed., CBS Publishers and Distributors, New Delhi, 1997. 2. Unit Operations of Chemical Engineering, W. McCabe, J. Smith and P. Harriot, 5 th Ed., McGraw Hill Book Co., New		

York, 1993.

3. Transport Processes and Unit Operations, C.J. Geankopolis, 3rd Ed., Prentice Hall of India, New Delhi, 1999.
4. Food Engineering Operations, J.G. Brennan, Butters Cowell and Lilley, 3rd Ed., Elsevier Applied Science, Amsterdam, 1990.
5. Engineering Properties of Foods, M. A. Rao, Syed S.H. Rizvi and Ashim K. Datta, 4th Ed., CRC Press, Florida, 2014.
6. Unit Operations of Agricultural Processing, K.M. Sahay and K.K. Singh, 3rd Ed., Vikas Publishing House, New Delhi, 2003.

AE13103 Farm Irrigation Systems: 3 Credits (2-0-2)		
Unit I	Major and medium irrigation schemes of India, purpose of irrigation, merits and demerits of irrigation, Sources of irrigation water, present status of development and utilization of different water resources of the country; measurement of irrigation water, water lifts and irrigation pumps.	6 lectures
Unit II	Soil-plant-water relationships, crop water requirement, irrigation efficiencies, irrigation scheduling.	6 lectures
Unit III	Land grading and field layout for efficient irrigation systems; water conveyance and its control.	4 lectures
Unit IV	Farm irrigation methods: border, check basin, furrow – adaptability, specification.	6 lectures
Unit V	Sprinkler and drip methods of irrigation – adaptability and layout.	6 lectures
Books:		
<ol style="list-style-type: none"> 1. Irrigation Theory and Practice, A.M. Michael, 2nd Ed., Vikas Publishing House, New Delhi, 2008. 2. Fundamentals of Irrigation Engineering, Bharat Singh, 8th Ed., New Chand and Brothers, Roorkee, 1997. 3. Drainage Engineering, J.N. Luthin, John Wiley and Sons, New York, 1970. 4. Irrigation Engineering, G.S. Birdie, and R.C. Das, 2nd Ed., Dhanpat Rai and Sons, New Delhi, 1996. 		

AE13104 Farm Power: 3 Credits (2-0-2)		
Unit I	Various sources of farm power: Mechanical, electrical and renewable sources. Status of farm power in India. Types of off-road vehicles. Trends in tractor design.	4 lectures
Unit II	Engine features: Combustion chamber, engine balancing, and flywheel. Engine performance characteristics: Torque, power and fuel consumption.	6 lectures
Unit III	Power transmission system of tractor: Clutch, gearbox, differential, final drive, PTO and brake.	7 lectures
Unit IV	Tractor steering system: Ackermann steering geometry, components and their adjustments. Electrical and electronic system: Alternator, starter motor, battery and wiring harness.	6 lectures
Unit V	Power tiller: Clutch, transmission gear, steering and brake. Tractor, power tiller and implement cost estimation, break even analysis.	5 lectures
Books:		
<ol style="list-style-type: none"> 1. Tractor and their Power Units, John B. Liljedahl, W.M. Carleton, P.K. Turnquist and H. Makotohoki, 4th Ed., CBS Publishers & Distributors, New Delhi, 1977. 2. Off-Road Vehicle Engineering Principles, Carroll E. Goering, Marvin L. Stone, David W. Smith and Paul K. Turnquist, American Society of Agricultural Engineers. St. Joseph, Michigan, 2003. 3. Engine and Tractor Power, Goering, Carroll E. and Alan C. Hansen, American Society of Agricultural Engineers. St. Joseph, Michigan, 2004. 		

AE13105 Agricultural Drainage: 3 Credits (2-0-2)		
Unit I	Water logging - causes and impacts; drainage, objectives of drainage, surface drainage coefficient, types of surface drainage; sub-surface drainage: purpose and benefits	4 lectures
Unit II	Drainage investigations, planning of surface and subsurface drainage systems; Hydraulic conductivity, drainable porosity, water table; derivation of Hooghoudt's and Ernst's drain spacing equations	8 lectures

Unit III	Drainage structures, vertical, bio, ditch, tube and mole drains	4 lectures
Unit IV	Salinity measurement, classification of salt affected soils; Reclamation of saline and alkaline soils, salt balance equation	6 lectures
Unit V	Leaching requirement for saline soils, gypsum requirement for alkali soils, Irrigation water quality, Water management in salt affected areas, conjunctive use of fresh and saline water.	6 lectures

Books:

1. Land Drainage, Principles, Methods and Applications, Bhattacharya AK and Michael AM, Vikas Publication House, Noida (UP), 2013.
2. Drainage Principles and Applications, Ritzema H.P., ILRI Publication, Second Edition (Completely Revised), 1994
3. Principles of Agricultural Engineering Vol-II, Michael AM. and Ojha TP., 5th Edition. Jain Brothers Publication, New Delhi, 2014.
4. Agricultural Drainage-Principles and Practices, Kadam U.S., Thokal R.T., Gorantiwar S.D. and Powar A.G. Westville Publishing House, New Delhi, 2007
5. Drainage Engineering, J.N. Luthin, John Wiley and Sons, New York, 1970.

AE13201 Hydrology and Soil Water Conservation: 3 Credits (2-0-2)

Unit I	Hydrologic cycle, precipitation, infiltration, evaporation, runoff.	6 lectures
Unit II	Land use capability classification, types and estimation of water and wind erosions.	5 lectures
Unit III	Conservation measures for hill slopes, agricultural lands, gullies; vegetative waterways and their design; stream bank erosion and its control.	8 lectures
Unit IV	Water harvesting and farm ponds, rate of sedimentation and loss of storage.	5 lectures
Unit V	Introduction to watershed management.	4 lectures

Books:

1. Soil and Water Conservation Engineering, G.O. Schwab, R.K. Frevert, T.W. Edminster and K.K. Barnes, 3rd Ed., John Wiley and Sons, New York, 1981.
2. Land and Water Management Engineering. V.V.N. Murthy, 2nd Ed., Kalyani Publishers, Ludhiana, 1985.
3. Introductory Soil and Water Conservation Engineering. B.C. Mal, Kalyani Publishers, Ludhiana, 1995.
4. Soil Conservation, Norman Hudson, B.T. Batsford, London, 1981.
5. Soil and Water Conservation Engineering, R. Suresh, 2nd Ed., Standard Publishers Distributors, Delhi, 1997.
6. Hydrology and Soil Conservation Engineering, Ghanshyam Das, Prentice Hall of India Pvt. Ltd. New Delhi, 2000.

AE13202 Agricultural Machinery: 3 Credits (2-0-2)

Unit I	Scope, need and constraints of mechanization. Types of implements: Mounted, semi mounted, trailed and self-propelled. Implement performance parameters: Field capacity, field efficiency.	4 lectures
Unit II	Tillage implements: Tillage methods, Mould board plough, disc plough, chisel plough, subsoiler, cultivator, harrows, rotary plough, lister, ridger, puddler and leveller.	6 lectures
Unit III	Sowing and planting equipment: Methods of sowing, functions, types of furrow opener and metering mechanism. Precision planting. Seed drill and planter: Power transmission system and calibration. No-till drill, strip-till drill and transplanter.	6 lectures
Unit IV	Plant protection equipment: Principles of atomization drip and drift, types of sprayers and their various components. Types of dusters. Interculture equipment: Manual and power operated.	6 lectures
Unit V	Harvesting equipment: Principles of cutting. Shear type harvesting devices: Mower, reaper, binder, windrower, and their adjustment. Threshing equipment: Principles of threshing, various types of threshers, and types of threshing cylinders. Thresher performance analysis.	6 lectures

Books:

1. Principles of Farm Machinery, R.A. Kepner, Roy Bainer and E.L. Berger, 1st Ed., CBS Publishers and Distributors, New Delhi, 1987.
2. Engineering Principles of Agricultural Machines, A.K. Srivastava, C.E. Goering and R.P. Rohrbach, 2nd Ed., American Society of Agricultural Engineers, Michigan, 2005.
3. Farm Machinery and Equipment, 6th Ed., H.P. Smith and L.H. Wilkis, Tata McGraw Hill Publishing Co. Ltd. New Delhi, 1988.
4. Principles of Agricultural Engineering, Vol.-I, A.M. Michael and T.P. Ojha, 3rd Ed., Jain brothers, New Delhi, 1978.

AE13203	Farm Engines: 3 Credits (2-1-0)	
Unit I	IC Engine: Basic classification, components and material of construction. CI and SI engines and their fundamental differences.	3 lectures
Unit II	Working principles of engine. Valve timing, ignition timing, and firing order. Power efficiencies and their measurements.	6 lectures
Unit III	Fuel and combustion: Important qualities of CI and SI engine fuels, and their rating. Combustion in CI and SI engines. Fuel system of CI and SI engines.	6 lectures
Unit IV	Ignition system. Intake and exhaust systems: air cleaner, mufflers, superchargers and turbochargers. Exhaust treatment systems like DPF, DOC and catalytic converter.	6 lectures
Unit V	Cooling system: Purpose and types of cooling, heat transfer during cooling, coolant and antifreeze, cooling system maintenance. Lubrication system: Theory of lubrication, types and properties of lubricant, types of lubrication system and their maintenance.	7 lectures

Books:

1. Fundamental of Internal Combustion Engine, P.W. Gill, J.H. Smith and E.J. Ziurys, 1st Ed., Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1954.
2. A course in Internal combustion Engine, M.L. Mathur and R. P. Sharma, 7th Ed., Dhanpat Rai and Sons, Delhi, 1994.
3. Engine and Tractor Power, Carroll E. Goering and Alan C. Hansen, American Society of Agricultural Engineers. Michigan, 2004.

AE13204	Heat and Mass Transfer in Food Engineering: 3 Credits (2-1-0)	
Unit I	Introduction to transfer process; Steady state conduction; Fourier law. Convection and radiation heat transfers; equations for radiative, convective and overall heat transfers for various geometries; Heat flow through slab, sphere and cylinder.	7 lectures
Unit II	Heat Exchangers: General introduction; Application of different types of heat exchanger; Fouling factor; Design concept of heat exchanger	5 lectures
Unit III	Heat exchanger flow: parallel, counter flow and cross flow. Concept of LMTD, effectiveness, NTU, use of charts for LMTD and LTU calculations. Design of tube in tube, shell and tube and plate heat exchangers.	7 lectures
Unit IV	Newtonian, and non-Newtonian fluids, laminar and turbulent flow through pipes and plates	5 lectures
Unit V	Introduction to mass transfer and their application in food engineering. Diffusive and convective mass transfer.	4 lectures

Books:

1. Transport Process and Unit Operations, C.J. Geankopolis, 3rd Ed., Prentice Hall of India, New Delhi, 1999.
2. Heat Transfer, J.P. Holman, 8th Ed., McGraw Hill Book Co., New York, 1977.
3. Transport Phenomena, Robert Byron Bird, Edwin N. Lightfoot and Warren E. Stewart, 8th Ed., John Wiley and Sons, New York. 1977.
4. Heat Transfer - A Basic Approach, M.N. Ozisik, McGraw Hill Book Co., New York, 1985.

AE13001	Agricultural Produce and Storage: 3 Credits (2-0-2)	
Unit I	Concept of water activity of foods, isotherm models, preservation of foods by lowering water activity. Drying of cereals, pulses & oilseed: EMC, psychrometry, drying mechanism of cereals, analysis of thin layer & deep bed drying, different types of dryers and their performance evaluation. Solar dryer.	6 lectures
Unit II	Importance of engineering properties of food in food processing. Milling technology: Milling of wheat, paddy and oil seeds. Parboiling of paddy. Oil extraction methods.	8 lectures
Unit III	Types and functional requirements of storage structures. Grain pests and rodents control. Pressure theory in grain storage. Grain flow behaviour in storage structure. Aeration and fumigation in storage structure. Scheduling of aeration.	5 lectures
Unit IV	Design features of various storage structures: controlled atmospheric storage, modified atmosphere storage, cold storage and frozen storage. Management of cold storage.	5 lectures
Unit V	Material handling: Application, conveyer, elevator. Design concept	4 lectures
Books:		
<ol style="list-style-type: none"> 1. Food Engineering and Dairy Technology, H.G. Kessler, Freising, West Germany: Verlag A. Kessler, 1981. 2. Handling and Storage of Food Grains, Food and Agriculture Organization of the U.N., Rome, 3rd Ed., Oxford IBH Pub. Co. Pvt. Ltd., New Delhi, 1980. 3. Storage of Potatoes, A. Rastovski and A.J.H. Van Es, International Book Distribution, Deharadun, 1989. 4. The Technology of Food Preservation, N.N. Desosier and J.N. Desosier, 4th Ed., CBS Publishers and Distributors, New Delhi, 1987. 5. Preservation and Storage of Grains, Seeds and their Bye Products, J.L. Multon, CBS Publishers and Distributors, New Delhi, 1989. 		

AE13002	Aquacultural Engineering: 3 Credits (2-1-0)	
Unit I	Types of culture practices and requirements for culturable species, selection of sites for aquacultural farm, hydrometeorological, environmental and engineering problems.	6 lectures
Unit II	Micro-level survey for planning and design, assessibilities, socio-economics conditions, water supply and quality, soil quality, available area, topography, vegetations.	6 lectures
Unit III	Components of a fish farm: transition, rearing ponds, layout of pond system. Design of dykes of fish farm.	6 lectures
Unit IV	Water management system: design of sluices, gates and canals for tide-fed and pump-fed farms, low level and highlevel reservoirs for pump-fed farm.	6 lectures
Unit V	Aquacultural equipment: pumps, aerators, feeders, blowers and filters.	4 lectures
Books:		
<ol style="list-style-type: none"> 1. Aquacultural Engineering, F.W. Wheaton, John Wiley & Sons, New York, 1977. 2. Costal Aquacultural Engineering, A.N. Bose, S.N. Ghosh, C.T. Yang and A. Mitra, Edward Arnold, London, 1991. 3. Text Book of Fish Culture, Breeding and cultivation of Fish, M. Huet, Fishing News Book Ltd., 1986. 		

AE13003	Food Safety and Standards: 3 Credits (3-0-0)	
Unit I	Basics of Food Science and Food Analysis, Concept, objectives and need of food quality. Instrumental method for testing quality	10 lectures
Unit II	Sensory evaluation methods, Instrumental method for testing quality. Food adulteration and food safety. TQM and TQC,	10 lectures
Unit III	Consumer preferences and acceptance, Food Safety Management Systems GAP, GHP, GMP, Hazards and HACCP (Hazard analysis and critical control point), Sanitation in food industry (SSOP), Food Laws and Regulations in India, FSSAI, Food grades and standards BIS,	6 lectures

Unit IV	Food adulteration and food safety. TQM and TQC,	10 lectures
Unit V	AGMARK, PFA, FPO, ISO 9000, 22000 Series. CAC (Codex Alimentarius Commission), Traceability and Quality Assurance system in a process plant, Bio safety and Bioterrorism	6 lectures

Books:

1. Hand book of Analysis and Quality Control for Fruit and Vegetable Products, Ranganna S.
2. A text book of Food Science and Technology, Sharma Avanthi.
3. Food Science, Mudambi Sumati R, Rao Shalini M and Rajagopal M.V.
4. Food Science, Potter NN and Hotchkiss J.H.
5. Quality for Value Addition in Food Processing, Dev Raj, Rakesh Sharma and Joshi V.K. The Food Safety and Standards Act along with Rules & Regulations. Commercial Law Publishers (India) Pvt. Ltd.

AE13004	Hydraulic Systems: 3 Credits (2-1-0)	
Unit I	Hydraulic Basics: Pascal's Law, Flow, Energy, Work, and Power. Hydraulic Systems, Color Coding, Reservoirs, Strainers and Filters, Filtering Material and Elements. Accumulators, Pressure Gauges and Volume Meters, Hydraulic Circuit, Fittings and Connectors.	6 lectures
Unit II	Pumps, Pump Classifications, operation, performance, Displacement, Design of Gear Pumps, Vane Pumps, Piston Pumps. Hydraulic Actuators, Cylinders, Construction and Applications, Maintenance, Hydraulic Motors.	7 lectures
Unit III	Valves, Pressure-Control Valves, Directional- Control Valves, Flow-Control Valves, Valve. Installation, Valve Failures and Remedies, Valve Assembly, Troubleshooting of Valves	4 lectures
Unit IV	Hydraulic Circuit Diagrams and Troubleshooting, United States of American Standards Institute USASI Graphical Symbols Tractor hydraulics, nudging system, ADDC.	7 lectures
Unit V	Pneumatics: Air services, logic units, Fail safe and safety systems Robotics: Application of Hydraulics and Pneumatics drives in agricultural systems, Programmable Logic Controls (PLCs)	4 lectures

Books:

1. Principles of Farm Machinery, Kepner RA, Roy Barger & EL Barger. CBC Publishers & Distributors, New Delhi.
2. Engineering Principles of Agricultural Machines, Srivastava A K, Carroll E. Goering & Roger P. Rohrbach. ASAE Text Book No. 6 Publ. ASAE, ISBN 0-929355-33-4.
3. Power Hydraulics, Pinches Michael J. & John G. Ashby. Prentice Hall International (UK) Ltd.
4. Tractors and Their Power Units, Liljedahl J B and Others. CBS Publishers, New Delhi.

AE13005	Land Grading and Earth Moving Machinery: 3 Credits (2-0-2)	
Unit I	Types of earth moving machinery. Hydraulic system: Components like pumps, valves, and cylinders. Repair and maintenance of hydraulic system.	6 lectures
Unit II	Crawler tractor: Differential, brake, clutch, suspension, track-assembly, and their repair and maintenance.	6 lectures
Unit III	Principles of operation of bulldozer, front end loader, excavator, power shovels and their applications in agricultural operations. Boring machines and different methods of boring.	6 lectures
Unit IV	Principles of operation of ditchers, scrapers, leveller, roller, grader, dump truck and load hoisting equipment and their applications in agricultural operations.	6 lectures
Unit V	Troubleshooting, repair, maintenance, cost of operation, and management of earth moving machines.	4 lectures

Books:

1. Land Reclamation Machinery, T. Borshchow, R. Mansurou and V. Sergeev, 1st Ed., MIR Publication, Moscow, 1988.
2. Manual of Tractor, J. Konrod, Asia Publishing House, Delhi.
3. Motor Grader, E.G. Roninson, MIR Publication, Moscow, 1985.

AE13006 Material Science and Engineering: 3 Credits (2-1-0)		
Unit I	Classification of engineering materials. Geometry of crystal: Space lattice, Space lattice and crystal structures. Determination of Crystal structure. Metallic bonding.	4 lectures
Unit II	Crystal imperfections and dislocations. Phase diagram and phase transformation. Fracture: Ductile and brittle fracture.	7 lectures
Unit III	Stress and strain in materials. plastic deformation; creep and mechanism of creep; elastic, anelatsic and viscoelastic behavior; Oxidation and corrosion	8 lectures
Unit IV	Mechanical property tests for materials: Destructive and non-destructive tests, tensile and compression tests, shear test, fatigue test, hardness test, impact test.	5 lectures
Unit V	Nonmetallic materials: Polymer, fibre, composite material, and ceramic materials; their types, properties, additives, and applications.	4 lectures
Books:		
1. Material Science and Engineering – A first Course, V. Raghavan, 6 th Ed., PHI Learning Pvt. Ltd. Delhi, 2015.		
2. Introduction to Engineering Materials, B.K. Agrawal, Tata McGraw-Hill Education, Delhi, 1988.		
3. Engineering Materials and Metallurgy, R.K. Rajput, 1 st Ed., S. Chand & Co. Ltd., New Delhi, 2006.		

AE13007 Tea Science and Technology: 3 Credits (2-1-0)		
Unit I	Tea production: soil and climate, plant propagation and nursery management, planting.	5 lectures
Unit II	Fertilizer application, irrigation and drainage, plant protection.	7 lectures
Unit III	Tipping, plucking, shifting and pruning.	5 lectures
Unit IV	Tea processing: Chemistry of tea processing and manufacturing, working principles of processing equipment and their maintenance.	7 lectures
Unit V	Transport and marketing, warehousing, testing and sale.	4 lectures
Books:		
1. Science and Practice in Tea Culture, D.N. Barua, 1 st Ed., Tea Research Association, Jorhat, 1989.		
2. Tea in India, BalaSubramaniam, 1 st Ed., Wiley Eastern Ltd., New Delhi, 1995.		
3. Tea Culture, Processing and Marketing, M.J. Mulky and V.S. Sharma, 1 st Ed., Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1993.		
4. Tea Production and Processing, Barundeb Banerjee, 1 st Ed., Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1996.		

AE13008 Tractor Systems: 3 Credits (2-0-2)		
Unit I	Human factors engineering: Operators exposure to environment, noise and vibration, operator machine interface, operator sitting. Safety of operator: Roll over protective structure and cab.	5 lectures
Unit II	Hydraulic system: Components such as pump, valve, actuator; working principle, symbols, flow circuit, automatic draft control system, automatic position control system, power steering.	7 lectures
Unit III	Traction mechanics, traction parameters, factors affecting traction performance, weight transfer, traction prediction models.	6 lectures
Unit IV	Drawbar performance, ballasting, determination of centre of gravity and moment of inertia of tractor. Tractor-implement matching.	6 lectures
Unit V	Tractor test codes and standards, engine and drawbar performance tests, hydraulic power and lifting capacity tests.	4 lectures
Books:		
1. Tractor and their Power Units, J.B. Liljedahl, W.M. Carleton, P.K. Turnquist and H. Makoto, 4 th Ed., CBS Publishers & Distributors, New Delhi, 1997.		
2. Off-Road Vehicle Engineering Principles, Carroll E. Goering, Marvin L. Stone, David W. Smith and Paul K. Turnquist, American Society of Agricultural Engineers, Michigan, 2003.		
3. Engine and Tractor Power, Carroll E. Goering and Alan C. Hansen, American Society of Agricultural Engineers, Michigan, 2004.		

4. The Mechanics of Tractor - Implement Performance, R. H. Macmillan, University of Melbourne, 2002,
Printed from: <http://www.eprints.unimelb.edu.au>.

AE13009 Unit Operations in Food Engineering: 3 Credits (2-1-0)		
Unit I	Material and energy balances involving solids, liquids and gases in dairy & food processing systems.	5 lectures
Unit II	Size reduction: Principles of size reduction. Energy requirement, machineries. Mixing and agitation: Principles of mixing. Mixing elements for low, moderate and high viscous materials. Mixing of solids.	6 lectures
Unit III	Dairy operations: homogenization, Heat transfer process: pasteurization, sterilization, Refrigeration, freezing, freeze concentration.	6 lectures
Unit IV	Separation process: filtration, centrifugation, sedimentation, distillation, solid liquid extraction, gas absorption, adsorption, crystallization, humidification and dehumidification. Membrane separation. Cyclone separation.	6 lectures
Unit V	Principle of Drying, different drying methods: conduction, convection & radiation drying. Microwave drying, Irradiation, freeze drying. Evaporation: methods & design concept, steam economy	5 lectures
Books:		
1. Fundamentals of Food Process Engineering, R.T. Toledo, 2 nd Ed., CBS Publishers and Distributors, New Delhi, 1997.		
2. Unit Operations in Chemical Engineering, W. McCabe, J. Smith and P. Harriot, 5 th Ed., McGraw Hill Book Co., New York, 1993.		
3. Transport Processes and Unit Operations, C.J. Geankopolis, 3 rd Ed., Prentice Hall of India, New Delhi, 1999.		
4. Food Engineering Operations, J.G. Brennan, N.D. Butters, N.D. Cowell and A.E.V. Lilley, 3 rd Ed., Elsevier Applied Science, Amsterdam, 1990.		

AE13010 Water Well and Pump Engineering: 3 Credits (2-1-0)		
Unit I	Occurrence and movement of groundwater, groundwater resources development and utilization, artificial recharge techniques.	4 lectures
Unit II	Well hydraulics; steady and unsteady flow towards a well in confined, unconfined; pumping tests	7 lectures
Unit III	Design, construction and development of tube wells.	7 lectures
Unit IV	Water lifting devices, reciprocating pump, centrifugal pump, characteristic curves and selection of pump.	7 lectures
Unit V	Economics of water pumping.	3 lectures
Books:		
1. Water Well and Pump Engineering, A.M. Michael and S.D. Khepar, Tata McGraw Hill Publishing Co. Ltd. New Delhi.		
2. Water Wells and Pumps, A.M. Michael, S.D. Khepar and S.K. Sondhi, Tata McGraw Hill Publishing Co. Ltd. New Delhi.		
3. Ground Water Hydrology, D.K. Todd, 2 nd Ed., John Wiley and Sons, New York, 1995.		
4. Ground Water, H.M. Raghunath, Wiley Eastern Limited, New Delhi, 1982.		

AE13021 Alternate Energy Sources: 3 Credits (2-1-0)		
Unit I	Concept and limitation of Renewable Energy Sources (RES), classification of RES: Solar, wind, geothermal, biomass, ocean energy sources, comparison of renewable energy sources with non-renewable sources.	4 lectures
Unit II	Solar energy conversion into heat by different collectors. Solar thermal devices. Natural and forced convection drying system, Solar Photo voltaic system. Energy through photovoltaic power generation and cost economics.	6 lectures
Unit III	Energy available in wind, lift and drag. Basis of wind energy conversion. Effect of wind speed and angle of attack. Types of windmill rotors, determination of torque coefficient, working principle of wind power plant.	6 lectures

Unit IV	Biomass and its resources. Pyrolysis of biomass to produce solid, liquid and gaseous fuels. Types of gasifier, biomass cook stoves for rural energy needs, briquetting and characteristics of briquettes. Economics of gasification of biomass.	6 lectures
Unit V	Biogas: Types of biogas plants, biogas generation, factors affecting biogas generation and usages, design consideration, application and advantages of biogas spent slurry.	6 lectures
Books:		
<ol style="list-style-type: none"> 1. Non-Conventional Sources of Energy, G. D. Rai, 4th Ed., Khanna Publishers, Delhi, 1996. 2. Non-Conventional Sources of Energy, O. P. Singhal, 1st Ed., Saroj Prakashan, Allahabad, 1996. 3. Solar Energy, S. P. Sukhatme, 2nd Ed., Tata McGraw Hill Publishing Co. Ltd. New Delhi, 1996. 4. Biotechnology, other Alternative Technologies for Utilization of Biomass/Agricultural Wastes, A. Chakraborty, 1st Ed., Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1989. 		

AE13022	Building Materials and Construction: 3 Credits (2-1-0)	
Unit I	Properties and classification of building materials like bricks, lime, cement, sand, coarse aggregates, timber, asbestos, glass etc.	5 lectures
Unit II	Constructional elements such as brick, stonework, mortar, concrete, plastering, painting, ceiling, roofing etc.	5 lectures
Unit III	Design of beams, columns and column footings, roof slabs, roof trusses etc.	9 lectures
Unit IV	Concept of detailed and abstract estimates, introduction to departmental schedules, estimation procedure for building, sheds and roads.	4 lectures
Unit V	Factors affecting building costs, cost evaluation of design and planning alternatives for building and estate development, measurement and pricing, economic methods for evaluating investments in buildings and building systems: cost-in-use, benefit-to-costs and savings-to-investment ratios, rate of return, net benefits, payback.	5 lectures
Books:		
<ol style="list-style-type: none"> 1. Farm Structures, H.J. Barre and L.L. Sammet, John Wiley and Sons Pvt. Ltd., New York, 1950. 2. Farm Service Buildings, H.E. Gray, McGraw Hill Book Co., New York, 1955. 3. Farm Buildings in Punjab, A.P. Bhatnagar, 1st Ed., PAU Ludhiana, 1976. 4. Planning Farm Buildings, John C. Wooley, McGraw Hill Co., New York, 1953. 5. Estimating and Costing, B.N. Dutta, UBS publishers, 2000. 		

AE13023	Hydrological Processes: 3 Credits (2-1-0)	
Unit I	Hydrology and its development, hydrologic cycle, measurement of hydrologic components, precipitation data analysis, stream flow measurement	4 lectures
Unit II	Infiltration modeling, ET estimation methods, runoff computation methods, relationship between rainfall and runoff	6 lectures
Unit III	Hydrograph, synthesis and analysis, base flow separation, unit hydrograph theory and its applications, synthetic hydrograph, S-curve	6 lectures
Unit IV	Flood peak, design flood and computation of probable flood; principles of flood routing, channel and reservoir routing	5 lectures
Unit V	Definition of watershed, geomorphological analysis of watershed, watershed prioritization, principles and practices of sustainable and integrated watershed management; watershed workplan	7 lectures
Books:		
<ol style="list-style-type: none"> 1. Engineering Hydrology, K. Subramanya, Tata McGraw-Hill, New Delhi, 1994. 2. Elementary Hydrology, V.P. Singh, 1st Ed., Prentice Hall of India, New Delhi, 1994. 3. Hydrology: Principles, Analysis and Design, H.M. Raghunath, 3rd Ed., New Age International, New Delhi, 2001. 4. Watershed Planning and Management, R.V. Singh, Yash Publishing House, Bikaner, 2000. 5. Soil and Water Conservation Engineering, R. Suresh, 2nd Ed., Standard Publisher and Distributors, New Delhi, 1997. 		

AE13024 Micro-Irrigation Systems: 3 Credits (2-0-2)		
Unit I	Present status, scope and potential problems; inventory of resources – water source, crop and soil information, land topography; data requirement; general rules for design	4 lectures
Unit II	Indigenous micro irrigation systems: pitcher, suction irrigation, bamboo drip irrigation system, low cost drip irrigation systems	5 lectures
Unit III	Sprinkler irrigation: adaptability, problems and prospects, types of sprinkler irrigation systems; design of sprinkler irrigation system: layout selection, hydraulic design of lateral, sub-main and main pipeline, design steps; selection of pump and power unit for sprinkler irrigation system; performance evaluation of sprinkler irrigation system; economics	8 lectures
Unit IV	Design of drip irrigation system: general considerations, wetting patterns, irrigation requirement, emitter selection, hydraulics of drip irrigation system, design steps; necessary steps for proper operation of a drip irrigation system; performance evaluation of drip irrigation system; economics; fertigation: uses, advantages and limitations	8 lectures
Unit V	Problems and maintenance of pressurized irrigation systems	3 lectures
Books:		
<ol style="list-style-type: none"> 1. Irrigation: Theory and Practice, A.M. Michael, Vikas Publishing House, New Delhi, 2012. 2. Principles of Sprinkler Irrigation systems, M.S. Mane and B.L. Ayare, Jain Brothers, New Delhi, 2007. 3. Principles of Drip Irrigation systems, M.S. Mane, B.L. Ayare and S.S. Magar, Jain Brothers, New Delhi, 2006. 4. Micro Irrigation – Theory and Practices, R. Suresh, Standard Publishers Distributors. 5. Micro irrigation for Crop Production, Developments in Agricultural Engineering Series, Vol. 13, Freddie R. Lamm, James E. Ayars, Francis S. Nakayama, Elsevier, 2006, 		

AE13025 Minor Irrigation: 3 Credits (2-1-0)		
Unit I	Status of irrigation projects in India, Types of minor irrigation system in India.	3 lectures
Unit II	Land grading field layout: Land grading, survey and design, land leveling design methods, construction procedures and contour leveling.	7 lectures
Unit III	Concept of command area, irrigation planning in an irrigated command area, irrigation scheduling polices - rotational and other methods of irrigation, water distribution in a command area.	7 lectures
Unit IV	Design of inverted siphons and outlets, pressure conduits, lining of irrigation conveyance system, estimation of seepage loss from unlined channels.	5 lectures
Unit V	On farm development works; Farmers' participation in command area development; cost estimation, Use of GIS and RS in Command area.	6 lectures
Books:		
<ol style="list-style-type: none"> 1. Irrigation Engineering and Hydraulic Structures, S.K. Garg, Khanna Publishers, New Delhi, 2006. 2. Watershed Planning and Management, R.V. Singh, Yash Publishing House, Bikaner, 2000. 3. Land and Water Management Engineering, V.V.N. Murty, 2nd Ed., Kalyani Publishers, New Delhi, 1985. 4. Irrigation Theory and Practice, A.M. Micheal, Vikas Publishing House Pvt. Ltd., New Delhi, 1985. 		

AE13026 Processing of Dairy Products: 3 Credits (2-0-2)		
Unit I	Milk Definition. Classification of milk. Physico-chemical properties of Milk Constituents. Food and Nutritive value of milk	5 lectures
Unit II	Dairy operations: homogenization, Heat transfer process: pasteurization, sterilization, UHT	5 lectures
Unit III	Manufacture, Packaging and Storage of Pasteurized milk- Receiving Filtration/Clarification - Cooling - Storage of raw milk. Standardisation	6 lectures
Unit IV	Preparation of milk products and methods: flavoured milk, butter, yoghurt, cream ghee, ice-cream, cheese, shrikhand and khoa.	7 lectures
Unit V	Quality control in milk processing. Marketing concept of dairy products. Design and concept of dairy plant.	5 lectures

Books:

1. Outline of Dairy Technology, S. Dey, Oxford University Press, Oxford, 1997.
2. Milk and Milk Products, Clarence Henry Eckles, Willes Barnes Combs and Harold Macy, 4th Ed., Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1998.
3. Indian Dairy Products, K.S. Rangana and K.T. Acharya, Asia Publishing House, New Delhi, 1974.
4. Principles of Dairy Processing, J.N. Warner, New Age International Pvt. Ltd., New Delhi, 1976.

AE13027	Ravines Land Development: 3 Credits (2-1-0)	
Unit I	Waste lands: definition and classification.	3 lectures
Unit II	Degraded soils: saline and sodic soils, acid soils, eroded soils; quality of water; erosion.	6 lectures
Unit III	Waste land development: agronomic, aquacultural, engineering, forest management practices.	8 lectures
Unit IV	Rehabilitation of degraded pasture; sand dunes and their stabilization; management of saline and sodic soils; shifting cultivation and land degradation; rehabilitation of ravine lands.	8 lectures
Unit V	Irrigation water: quality and standards; utilization of saline water in agriculture.	3 lectures

Books:

1. Technology for Waste Land Development, I.P. Abrol and V.V. Dhruva Naryana, 1st Ed., ICAR Publication, New Delhi, 1990.
2. Technology of Waste Lands Development, Ram Prasad, 1st Ed., Associated Publishing Co., New Delhi, 1988.
3. Waste Land Management in India, Anil Kumar and R.N. Pandey, 1st Ed., Ashish Publishing House, New Delhi, 1989.

AE13041	Basics of Remote Sensing and GIS: 3 Credits (2-1-0)	
Unit 1	Basics of remote sensing, energy sources and radiation principles, energy interactions with earth surface features and atmosphere; reflectance curves.	5 lectures
Unit 2	Earth resource satellites, sensors, micro-wave remote sensing.	5 lectures
Unit 3	Aerial photographs; elements of photogrammetry; interpretation of aerial photographs; interpretation of satellite images.	6 lectures
Unit 4	Digital image processing: image rectification, enhancement, classification and its accuracy.	6 lectures
Unit 5	Geographic information system; GIS data models; overview of GIS software; GPS; application of RS and GIS technologies.	6 lectures

Books:

1. Introduction to Environmental Remote Sensing, E.C. Barret and L.F. Curtis, 3rd Ed., Chapman and Hall, London, 1992.
2. Remote Sensing and Geographical Information System, Mangi Reddy, 2nd Ed., B.S. Publications, 2002.
3. Remote Sensing and Image Interpretation, I.M. Lillesand and R.W. Keifer, John Wiley and Sons Inc., New York, 2000.
4. Fundamentals of Geographic Information System, Michael N. DeMers, 2nd Ed., John Wiley & Sons, 1999.

AE13042	Introduction to Computer Aided Design using Solidworks: 3 Credits (0-0-5)	
Unit I	Introduction to Solidworks: Various products available in SolidWorks for Product Design & Assembly Modelling. Solidworks GUI.	
Unit II	Introduction to sketch entities and sketch tools. Dimension: Creating different types of dimensions.	
Unit III	Creating different types of features like extrude, revolve, loft etc. Creating fillet, hole, chamfer, shell etc. Creating patterns.	
Unit IV	Introduction to assembly modelling. Applying different types of mates to parts.	
Unit V	Generating Views - Generating Model View, Projected Views, Inserting Standard 3 View. Creating a 2-D drawing from a 3-D model. Inserting Annotations.	

Books:

1. Mastering SolidWorks, Matt Lombard, 1st Ed., John Willey and Sons Ltd., Indianapolis, 2019.
2. Beginner's Guide to SOLIDWORKS 2021 - Level I, Alejandro Reyes, 1st Ed., SPC Publications Pvt. Ltd., Kansas City, 2020.

DEPARTMENT OF CIVIL ENGINEERING

Year I Semester I						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	HS11101	Remedial English – I	2	0	2	03
2.	PH11101	Physics – I	3	0	2	04
3.	CY11101	Chemistry – I	3	0	2	04
4.	MA11101	Mathematics – I	3	1	0	04
5.	ES11151	Engineering Drawing	0	0	6	03
6.	ES11152	Workshop Practice	0	0	4	02
Total						20

Year I Semester II						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	HS11201	Remedial English – II	2	0	2	03
2.	PH11201	Physics – II	3	0	2	04
3.	CY11201	Chemistry – II	2	0	2	03
4.	MA11201	Mathematics – II	3	1	0	04
5.	ES11200	Basic Electrical and Electronics Engineering	3	0	2	04
6.	CE11201	Construction Materials	3	0	0	03
7.	CE11251	Civil Engineering Drawing – I	0	0	4	02
Total						23

Year II Semester III						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	MA12101	Mathematics – III	3	1	0	04
2.	ES12100	Basics of Computer and Programming	2	0	2	03
3.	CE12101	Building Construction and Maintenance	3	0	2	04
4.	CE12102	Water Supply and Sanitary Services	2	0	2	03
5.	CE12103	Surveying – I	2	0	4	04
6.	CE12151	Civil Engineering Workshop	0	0	4	02
7.	CE12152	Civil Engineering Drawing – II	0	0	6	03
Total						23

Year II Semester IV						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	HS12201	Fundamentals of Entrepreneurship	3	0	0	03
2.	CE12201	Estimating and Quantity Surveying	2	1	0	03
3.	CE12202	Surveying – II	2	0	4	04
4.	CE12203	Technical Mechanics	3	1	0	04
5.	CE120**	Programme Elective – I	*	*	*	03
6.	HS12277	Essence of Indian Traditional Knowledge (Audit)	2	0	0	00
7.	CE12279	Winter Internship	0	0	0	03
8.	ED12288	Extra-Curricular Activities and Discipline	0	0	0	02
Total						22

Year III Semester V						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	CE13101	Fundamentals of Mechanics of Solid	2	1	0	03
2.	CE13102	Fundamentals of Fluid Mechanics	2	0	2	03
3.	CE13103	Basics of Geotechnical Engineering	2	0	2	03
4.	CE13104	Basics of Transportation Engineering	2	0	2	03
5.	CE13105	Fundamentals of Environmental Engineering	2	0	2	03
6.	CE130**	Programme Elective – II	*	*	*	03

7.	CE130**	Programme Elective – III	3	0	0	03
8.	**1304*	Open Elective – I	*	*	*	03
9.	CE13199	Project – I	0	0	2	01
					Total	25

Year III Semester VI						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	CE13201	Basics of Structural Analysis and Steel Structures	4	0	0	04
2.	CE13202	Fundamentals of RCC Structures	3	0	0	03
3.	CE13203	Water Resources Engineering	2	0	2	03
4.	CE130**	Programme Elective – IV	3	0	0	03
5.	**1304*	Open Elective – II	*	*	*	03
6.	**1304*	Open Elective – III	*	*	*	03
7.	HS132**	Indian Constitution (Audit)	2	0	0	00
8.	CE13289	Seminar	0	0	2	01
9.	CE13299	Project – II	0	0	6	03
					Total	23

LIST OF ELECTIVES

Programme Elective – I						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	CE12001	Advanced Construction Technology	3	0	0	03
2.	CE12002	Concrete Technology	2	0	2	03
3.	CE12003	Precast and Prestressed Concrete	3	0	0	03
4.	CE12004	Rural Construction Technology	3	0	0	03

Programme Elective – II						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	CE13001	Traffic Engineering	3	0	0	03
2.	CE13002	Solid Waste Management	3	0	0	03
3.	CE13003	Surveying and Geomatics	2	0	2	03

Programme Elective – III						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	CE13011	Green Building and Energy Conservation	3	0	0	03
2.	CE13012	Energy Science and Engineering	3	0	0	03
3.	CE13013	Pavement Design and maintenance	3	0	0	03
4.	CE13014	Building Services and Maintenance	3	0	0	03

Programme Elective – IV						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	CE13021	Repairs and Maintenance of Structures	3	0	0	03
2.	CE13022	Advanced Design of Structures	3	0	0	03
3.	CE13023	Tendering and Accounts	3	0	0	03

Open Elective – I						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	CE13041	Biological Waste Water Treatment	3	0	0	03

Open Elective – II						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	CE13042	Pavement Materials	3	0	0	03

Open Elective – III						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	CE13043	River Engineering	3	0	0	03

COURSE CONTENT

ES11151	Engineering Drawing: 3 Credits (0-0-6)	
Unit I	Conventional lines & Lettering; Scales.	
Unit II	Engineering curves: Conic sections, Cycloid, Involute, Spirals, Helix, etc.; Projection of Points and Straight lines; Projection of Planes.	
Unit III	Projection of Solids.	
Unit IV	Projection on Auxiliary Planes; Section of Solids; Development of surfaces; Isometric Views, Orthographic projections.	
Unit V	Related Drawings on AutoCAD /relevant softwares	
Books:		
<ol style="list-style-type: none"> 1. Elementary Engineering Drawing (53e), N.D. Bhatt and V. M. Panchal, Charotar Publishing House, Anand, India, 2014. 2. Engineering Drawing, Venugopal, Wiley Eastern Ltd, New Delhi, 1998. 3. Engineering Drawing and Graphics Technology, T. E. French, C.S. Verick and R. J. Forester, McGraw Hill International, Singapore, 1993. 4. Engineering Drawing (3e), B Agrawal and C. M. Agrawal, McGraw Hill, 2019 5. AutoCAD 2018 Training Guide, Linkan Sagar, BPB Publication, New Delhi, 2018. 		

CE11201	Construction Materials: 3 Credits (3-0-0)	
Unit I	Introduction to construction materials, selection of materials for different civil engineering works. Rock: classification, quarrying and dressing. Bricks: manufacturing processes, classification, and tests. Flooring and roofing tiles.	10 lectures
Unit II	Production, properties and uses of lime; cement and sand-mortar. Concrete: Plain and reinforced.	10 lectures
Unit III	Timber: types and methods of preservation, plywood. Iron and structural steel. Introduction to modern construction materials: laminated timber board, MDF board, ACC blocks, wall fabric materials, etc.	10 lectures
Unit IV	Types and uses of paints; varnishes and distemper.	6 lectures
Unit V	Sound and heat insulating materials; glasses; plastics and asphaltic materials.	6 lectures
Books:		
<ol style="list-style-type: none"> 1. Basic Civil Engineering, Dr. B. C. Punmia, Ashok K. Jain and Arun K. Jain, Laxmi Publication, 2003. 2. Engineering Materials, Rangwala, S.C., Charotar Publishing House, Anand, India, 2016. 3. Elements of Civil Engineering, Dr. Anurag Kandya, Charotar Publishing House, Anand, India, 2015. 4. Building Materials, S. K. Duggal, New Age International Publisher New Dehli, 2019. 		

CE11251	Civil Engineering Drawing – I: 2 Credits (0-0-4)	
Unit I	Orthographic Views; Oblique Views; Perspective Views; Signs and symbols of building materials.	
Unit II	Bond in Brick Masonry (orthographic and isometric); Bonds in Stone Masonry; Sub-structure details; Doors, windows and ventilators; Arches and Lintels; Timber joints and Trusses.	
Unit III	Riveted Bolted and Welded Joined; Steel Truss, Reinforcement details in beams and columns; Staircases.	
Unit IV	Single Storeyed Residential Buildings (pitched roof) -Type II, Double Storeyed Residential Building with Flat Roof -Type III.	
Unit V	Simple drawings of above topics on computer Graphics.	
Books:		
<ol style="list-style-type: none"> 1. Civil Engineering Drawing, R.S.Malik& G.S. Meo, New Asian Publications, Delhi, 1987. 2. Civil Engineering Drawing, M. Chakraborty, Author, Calcutta, 1996. 3. Principles of Building Drawing, Shah M.G., and Kale C.M., MacMillan India Ltd, New Delhi, 1995. 4. Building Drawings, Shah M.G., Kale C.M. and Patki S. Y., Tata McGraw Hill, New Delhi, 2017. 5. Related Softwares. 		

CE12101	Building Construction and Maintenance: 4 Credits (3-0-2)	
Unit I	Foundation: classification and construction, brick masonry, partition, cavity and curtain walls, scaffolding, underpinning and shoring.	10 lectures
Unit II	Door and windows; solar passive aspects of windows; brick and RCC arches and lintels.	8 lectures
Unit III	Roofs: classification and coverings; floors: ground and upper floors; cement, concrete, mosaic, stone, tile, laminated timber and other floors; damp proofing treatment in various components of building.	8 lectures
Unit IV	Stairs; protective and decorative finishes, wall papering, tiling, stone cladding.	8 lectures
Unit V	Maintenance and repairs of foundations, walls, floors, roofs, wooden and metal parts, and strengthening, retrofitting, rehabilitation of old and damaged structures.	8 lectures
Books:		
<ol style="list-style-type: none"> 1. Building Construction, B.C. Punmia, Laxmi Publishers, New Delhi, 1998. 2. Building Construction, Shushil Kumar, Standard Publishers, Delhi, 1999. 3. Building Construction Vol. I to IV, W.B. Mackey, Orient Longman, Mumbai, 1993. 4. Building Construction and Materials, Gurucharan Singh, Standard Book House, New Delhi, 2010. 5. Practical Handbook on Building Construction, M. K. Gupta, Nabhi Publication, New Delhi, 2005. 6. Maintenance of Building, A.C. Panchdhari, New Age International, New Delhi, 1997. 7. Maintenance Manual, CPWD 2012. 8. National Building Code, BIS, New Delhi, 2005. 		

CE12102	Water Supply and Sanitary Services: 3 Credits (2-0-2)	
Unit I	Sources of water, wells, tube wells, method of construction, types of pumps, with fittings.	5 lectures
Unit II	Collection of surface water and its conveyance through pipes, pipe laying, lake and corrosion in pipes and their remedial measures.	6 lectures
Unit III	Appurtenances in distribution system, sanitary systems –conservancy and water carriage systems, construction and maintenance of privies, septic tanks, imhoff tanks.	7 lectures
Unit IV	Construction and maintenance of sewers, sewer appurtenances.	5 lectures
Unit V	Plumbing equipments and operations, Water supply and sanitary fittings, house drainage, concepts of rural water supply and sanitation.	5 lectures
Books:		
<ol style="list-style-type: none"> 1. Environmental Engineering Vol. I: Water Supply Engineering, S.K. Garg, Khanna Publishers, Delhi, 1998. 2. Environmental Engineering Vol. II: Sewage Disposal & Air Pollution Engineering, S.K. Garg, Khanna Publishers, Delhi, 1998. 3. Wastewater Engineering: Treatment, Disposal & Reuse, Metcalf & Eddy, Tata McGraw Hill, New Delhi, 1991. 4. Elements of Public Health Engineering, K.N. Duggal, S. Chand & Co, New Delhi, 2000. 5. Water Supply & Sanitary Engineering, S.C. Rangawala, Charotar Publishing House, Anand, India, 2000. 6. Water Supply and Sanitary Installations, A C Panchdhari, New Age International, New Delhi, 1993. 		

CE12103	Surveying – I: 3 Credits (2-0-2)	
Unit I	Introduction, classification of survey, chain surveying - principle, instruments used, procedure, problems and errors in chain survey.	7 lectures
Unit II	Compass surveying: types, description and uses.	3 lectures
Unit III	Measurement of bearings in WCB and QB systems, local attraction and related problems.	4 lectures
Unit IV	Plane table surveying: methods of plane tabling, two- point and three- point problems and their solutions, errors in plane tabling.	7 lectures
Unit V	Leveling: leveling principles, booking and reduction of levels, different types of leveling, related problems and practices.	7 lectures

Books:
1. Surveying Vol. I, B.C.Punamia, Laxmi Publications, New Delhi, 2016.
2. Surveying Vol. I, S.K.Duggal, Tata McGraw Hill, New Delhi, 2019.
3. Surveying and Levelling Vol. I, T.P. Kanetkar and S.V. Kulkarni, Pune Vidyarthi Griha Parkashan Pune, 2010
4. Surveying & Levelling, Rangwala, Charotar Publishing House, Anand, India, 2014.
5. Surveying Vol.I, Dr. K.R. Arora, Standard Book House, Delhi, 2018.

CE12151	Civil Engineering Workshop: 2 Credits (0-0-4)
Unit I	Plumbing work: bending, cutting, threading.
Unit II	Practice in cutting, bending, and fixing reinforcement in RCC work.
Unit III	welding of rods, angles with gusset plates.
Unit IV	fabrication of steel frames.
Unit V	assembly of frames and shutters of doors and windows and trusses
Books:	
	1. Workshop Practice Manual, for Engineering, Diploma and ITI students : R.K Hedge.
	2. Mechanical Workshop Practice: K.C. John.
	3. Practical Guide Book Series, "Carpentry and Woodwork": Railway Engineering Technical Society Pune-India.

CE12152	Civil Engineering Drawing – II: 3 Credits (0-0-6)
Unit I	Residential Buildings, Industrial building, Public building, Bar bending schedule, Structural drawings of RCC elements.
Unit II	Beam column and eccentric connections in steel structures, Pipe joints, Septic tanks and soak pits, manholes.
Unit III	Culverts, Bridges, Dams, Weir and Barrage, and cross Drainage works, Hydrographs & Reservoir area capacity curve.
Unit IV	Cross sectional details of pavements/road and railway tracks; units of water treatment plant and sewage treatment plant.
Unit V	Simple drawing of above topics in computer graphics.
Books:	
	1. Civil Engineering Drawing, Malik & Meo, New Asian Publications, Delhi, 1987.
	2. Civil Engineering Drawing, M. Chakraborty, Author, Calcutta, 1996.
	3. Design of Steel Structures, Kazmi & Jindal, Prentice Hall & India, New Delhi, 1987.
	4. Civil Engineering Drawing Manual, Thanikachalam & Natarajan, S. Chand & Co., New Delhi, 1984.
	5. Building Drawings, Shah M.G, Kale C.M. and Patki S. Y., Tata McGraw Hill, New Delhi, 1993.
	6. Irrigation and WaterPower Engineering. B.C. Punmia and B B Lal, Standard Publishers & Distributors, Delhi, 1986.
	7. Related softwares.

CE12201	Estimating and Quantity Surveying: 3 Credits (2-1-0)	
Unit I	Unit of measurements and payments, Methods of estimates & examples.	4 lectures
Unit II	Preparation of detailed estimates of earthwork, masonry, concreting, flooring.	6 lectures
Unit III	Estimates of plastering, white washing and painting, wood and steel work, RCC work and sanitary fittings, Estimate preparation for buildings, roads,.	6 lectures
Unit IV	Estimate preparation for culvert, water tank, septic tank and retaining wall.	8 lectures
Unit V	Rate analysis for construction materials and various items of work.	4 lectures
Books:		
	1. Estimating & Costing in Civil Engineering, B.N. Dutta, UBS Publishers Distributors Ltd., New Delhi1, 1998.	
	2. Estimating, Costing, Specifications & Valuation, M Chakraborty, Author, Calcutta, 1992	
	3. Estimating & Costing Professional Practice, S.C. Rangwala, Charotar Publishing House, Anand, India, 1995.	
	4. Quantity Surveying: Estimating and Costing, P L Bhasin, S Chand & Co, Delhi, 1982.	

CE12202 Surveying – II: 4 Credits (2-0-4)		
Unit I	Introduction to theodolite: components and their functions, temporary adjustment; setting up of theodolite.	6 lectures
Unit II	Measurement of horizontal and vertical angles, direct and deflection angles, field notes.	4 lectures
Unit III	Adjustment of errors, setting out straight lines through obstacles like ponds, buildings, hills etc.	4 lectures
Unit IV	Permanent adjustment of theodolite, theodolite traversing, Height and Distance problems.	7 lectures
Unit V	Omitted measurements and calculations, methods of computation of areas and volumes.	7 lectures
Books:		
<ol style="list-style-type: none"> 1. Surveying Vol. I & II, B.C.Punamia, Laxmi Publications, New Delhi, 2005. 2. Surveying Vol. I & II, S.K.Duggal, Tata McGraw Hill, New Delhi, 1996. 3. Surveying and Levelling Vol. I & II, T.P. Kanetkar and S.V. Kulkarni, Pune VidyarthiGrihaParkashan Pune, 2000. 4. Surveying & Levelling, Rangwala, Charotar Publishing House, Anand, India, 2014. 5. Surveying Vol.I, Dr. K.R. Arora, Standard Book House, Delhi, 2013. 6. Surveying and Levelling, N.N. Basak, Tata McGraw Hill, New Delhi, 1994. 		

CE12203 Technical Mechanics: 4 Credits (3-1-0)		
Unit I	Forces in a plane and equilibrium of particles: vector operations, multiplication and division of a vector by a scalar, vector addition, vector subtraction, resolution of a vector, forces on a particle, resultant of two forces, addition of a system of coplanar forces, rectangular component of a force, Unit vectors, Equilibrium of a particle.	8 lectures
Unit II	Equilibrium of rigid bodies: external and internal forces, equivalent forces, vector product of two vectors, moment of a force about a point, Varignon's theorem, rectangular components of the moment of a force, moment of a force about a given axis, replacing a force with an equivalent force-moment system at a given point, replacing a force-moment system (with F perpendicular to M) with a single equivalent force, free body diagram, equilibrium of rigid body in two dimensions, equilibrium of a two-force body, equilibrium of a three-force body	14 lectures
Unit III	Friction: Laws of dry friction, coefficient of friction, angle of friction, problems involving dry friction.	8 lectures
Unit IV	Kinematics of particles: rectilinear Motion: position, displacement, velocity, and acceleration, determination of rectilinear motion, relative rectilinear motion, dependent rectilinear motions.	6 lectures
Unit V	Kinematics of particles: curvilinear motion: position vector, velocity, and acceleration, free flight of a projectile, tangential and normal components, radial and transverse components, cylindrical components	6 lectures
Books:		
<ol style="list-style-type: none"> 1. Vector Mechanics for Engineers, Statics and Dynamics, Beer and Johnston, Tata McGraw Hill, New Delhi, 1999. 2. Engineering Mechanics, Statics and Dynamics, Hibbeler, Pearson Education Asia Pvt. Ltd., New Delhi, 1997 3. Engineering Mechanics, Statics and Dynamics, Meriam and Kraige, John Wiley & Sons, NY, 1997. 4. Engineering Mechanics, S Timoshenko, D H Young, and J V Rao, Tata McGraw Hill, New Delhi 2007. 5. Engineering Mechanics, S SBhavikatti, K G Rajashekarappa, John Wiley, NY, 1994. 		

CE13101 Fundamentals of Mechanics of Solid: 3 Credits (2-1-0)		
Unit I	Mechanical Properties of Material, Axial Load, Direct shear, and Torsion: Stress-strain diagram for mild steel in tension and compression, Elastic behavior, Yield point, Strain hardening point, Stress-strain behavior of brittle materials, Hooke's law, Modulus of Resilience, Modulus of toughness, Poisson's ratio, Elastic deformation of an axially loaded member, Thermal stress, Direct shear stress, Shear strain, Modulus of rigidity, Torsion of a circular shaft, Power transmission, Deformation of a circular shaft, Angle of twist.	8 lectures
Unit II	Shear and Bending Moment Diagrams, Pure Bending: Shear force and bending moment at any point along the length of a beam, Regions of distributed loads, Concentrated loads and moments, Shear force and bending moment diagrams, bending of a straight beam, Simple beam theory, bending stress and its distribution, Composite beams, Transformed section.	8 lectures
Unit III	Transverse Shear: Shear on the horizontal face of a beam element, Horizontal shear per unit length, Transverse shear stress, The shear formula, Distribution of shear stress on the cross-section of a beam, Shear stress in the web of a thin-walled section.	4 lectures
Unit IV	Plane Stress Transformation: General equation of transformation of plane stress, Principal stresses- magnitudes and their planes, Max shear stress and its plane, Mohr circle for plane stresses, Analytical and graphical solution of problems of plane stress.	4 lectures
Unit V	Deflection of Beams: Deformation of a beam under transverse loading, The elastic curve, Moment-curvature relationship, Slope and deflection by direct integration, Boundary and continuity conditions, Equation of the elastic curve, Maximum deflection.	4 lectures
Books: <ol style="list-style-type: none"> 1. Elements of Strength of Materials, Timoshenko and Young, EWP, New Delhi, 1968 2. Strength of Material, G.H. Ryder, MacMillan, ELBS, London, 1969. 3. Engineering Mechanics of Solids, E.P. Popov, Prentice Hall of India, New Delhi, 1990. 4. Mechanics of Materials, Gere & Timoshenko, CBS Publications, New Delhi, 1984. 5. Strength of Material, Andrew Pytel and Ferdinand L. Singer, Harper Collins Publishers, India, New Delhi, 1991. 		

CE13102 Fundamentals of Fluid Mechanics: 3 Credits (2-0-2)		
Unit I	Properties of fluid: mass density, relative density, viscosity, fluid pressure, pressure head. Fluid statics - Pressure at a point, units of measurement, manometers,	5 lectures
Unit II	Forces on plane areas, line of action of force, force components on curved surfaces.	5 lectures
Unit III	Fundamentals of fluid flow - steady, unsteady, uniform, non-uniform, one dimensional, two dimensional and three-dimensional flows; Streamline, stream tube, irrotational flow, velocity potential, stream function, flow net, motion of a fluid element, acceleration of a fluid particle in a velocity field, fluid rotation, fluid deformation,	6 lectures
Unit IV	equation of continuity, energy equation and its applications.	4 lectures
Unit V	Fluid measurements - velocity measurement, Pitot tube, coefficient of discharge, coefficient of velocity, coefficient of contraction, orifices, orifice meter, venturimeter, time to empty tanks, weirs and notches.	8 lectures

Books:	
1. Hydraulics and Fluid Mechanics including Hydraulics Machines, Modi, P.N. and S.M. Seth, Standard Book House, Delhi, 1998.	
2. Theory and Problems of Fluid Mechanics, Subramanya, K, Tata McGraw Hill, New Delhi, 1993.	
3. Fluid Mechanics through Problems, Garde R.J., New Age International, New Delhi., 1989.	
4. A Text Book of Fluid Mechanics, Rajput, R.K., S. Chand & Co, New Delhi., 1998.	
5. Fluid Mechanics Hydraulics & Hydraulic Machines, Arora, K.R., Standard Publishers & Distributions, Delhi., 1999.	

CE13103	Basics of Geotechnical Engineering: 3 Credits (2-0-2)	
Unit I	Introduction, definitions and relationships; Index properties of soils.	5 lectures
Unit II	Soil classification; Soil structure.	3 lectures
Unit III	Soil compaction; Permeability and Seepage.	5 lectures
Unit IV	Effective stress; Stress distribution in soil mass; One dimensional consolidation.	8 lectures
Unit V	Shear strength of soils and shear tests.	7 lectures
Books:		
1. Murthy V.N.S, Textbook of Soil Mechanics and Foundation Engineering, ISBN: 9788123913629, 9788123913629, CBS Publishers & Distributors; 1st edition (2008).		
2. Singh Alam, Soil Engineering in Theory and Practice, Vol 1, Fundamentals and General Principles, CBS Publishers & Distributors; 4 th edition (2002).		
3. Das B.M., Fundamentals of Geotechnical Engineering, Brookes & Cole Publications, ISBN-10: 0534492940, ISBN-13: 978-0534492946, 2 nd revised edition (2004).		

CE13104	Basics of Transportation Engineering: 3 Credits (2-0-2)	
Unit I	Geometric Design of Highways - Factors, cross-section elements,	4 lectures
Unit II	Sight distances, horizontal and vertical curves, and transition curves, Related Practice.	6 lectures
Unit III	Traffic Engineering: Introduction, traffic characteristics,	6 lectures
Unit IV	Traffic sign and signal, traffic control devices.	4 lectures
Unit V	Railways: Geometrics for Broad Gauge, Cant deficiency, Sleeper Density, Design of Ballast Depth. Points and Crossings, Station and Yards, Signals.	8 lectures
Books:		
1. Highway Engineering, S K Khanna, C E G Justo and A.Veeraraghavan, Nem Chand & Brothers, Roorkee, India, 2015.		
2. Principles of Transportation Engineering, P. Chakroborty and A. Das, Prentice Hall of India Pvt. Ltd., 2003.		
3. Railway Engineering, Chandra, Satish, Agarwal, M.M., OXFORD University Press, New Delhi, 2013.		
4. A Text Book of Railway Engineering, Arora and Saxena, Dhanpat Rai & Sons, New Delhi, 2010.		

CE13105	Fundamentals of Environmental Engineering: 3 Credits (2-0-2)	
Unit I	Introduction, Estimation of quantity of water, per capita demand, design period, population forecasting.	5 lectures
Unit II	Sources of water and their suitability with regard to quality & quantity, storage capacity of reservoirs, water quality parameters, standards.	5 lectures
Unit III	Treatment of water- screenings, sedimentation, aeration, coagulation and flocculation, filtration & disinfection, Storage Reservoir, distribution system, methods of water supply.	5 lectures
Unit IV	Sewerage system, estimation of quantity of sewage, dry weather flow (DWF), wet weather flow (WWF), variation in flows, hydraulic design of sewers, pumping of sewage.	5 lectures
Unit V	Characteristics of sewage, strength of sewage, population equivalent, treatment of sewage- primary and secondary treatments, oxidations ponds, sewage disposal, self-purification of streams, sludge digestion and disposal, concept of air pollution control.	8 lectures

Books:

1. Environmental Engineering Vol. I: Water Supply Engineering, S.K. Garg, Khanna Publications, Delhi, 2017.
2. Environmental Engineering Vol II: Sewage Disposal and Air Pollution Engineering, S.K. Garg, Khanna Publications, Delhi, 2018.
3. Environmental Engineering, Peavy, Tachobanoglous & Rowe, McGraw Hill International, N.Y., 2017.
4. Wastewater Engineering: Treatment, Disposal and Reuse, (4e), Metcalf & Eddy, Tata McGraw Hill, New Delhi, 2017.
5. Water Supply Engineering (Environmental Engineering Vol. I): P. N. Modi, Standard Book House, N. Delhi, 2010.
6. Water Supply & Sanitary Engineering, G.S. Birdi and J.S. Bindie, Dhanpat Rai Publishing Co., New Delhi, 2010.

CE13201	Basics of Structural Analysis and Steel Structures: 4 Credits (4-0-0)	
Unit I	Three hinged arches, cables and suspension bridges; Influence line diagram for reaction, shear and bending moment for determinate beams, arches and trusses.	10 lectures
Unit II	Deflection by moment-area, conjugate beam, and energy methods. Design of riveted, welded and bolted connections.	16 lectures
Unit III	Degree of indeterminacy and stability; Principle of superposition, Betti's Law, Castigliano's theorem; Analysis of indeterminate beams by strain-energy and virtual work methods.	10 lectures
Unit IV	Design of tension and compression members; design of columns with splicing, lacing and battening.	10 lectures
Unit V	Design of beam-column connections; Column bases, foundation; Roof trusses.	10 lectures

Books:

1. Theory and Analysis of Structure Vol. II, O.P. Jain and A S Arya, Nem Chand & Brothers, Roorkee, India, 1976.
2. Basic Structural Analysis, C.S. Reddy, Tata McGraw Hill, New Delhi, 1996.
3. Theory of Structures, Timoshenko & Young, McGraw Hill International, Singapore, 1965.
4. Steel Structures, A.S. Arya and J.L. Ajmani, Nem Chand & Brothers, Roorkee, India, 1996.
5. Design of Steel Structure, P. Dayaratnam, Wheelers Publishing, Allahabad, 1990.
6. Design of Steel Structure, Kazmi and Jindal, Prentice Hall of India, New Delhi, 1987.

CE13202	Fundamentals of RCC Structures: 3 Credits (3-0-0)	
Unit I	Introduction to design; Concrete and Reinforced Concrete. Philosophy of Limit State Design; Different limit states. Characteristic strengths and loads; codal provisions; design values/parameters.	8 lectures
Unit II	Design for flexure of singly and doubly reinforced rectangular beams. Design for flexure of flanged beams T and L beams.	14 lectures
Unit III	Design of beams for shear, torsion, development and bond, control of deflections in beams and slabs.	6 lectures
Unit IV	One way, Two way and Continuous slabs.	8 lectures
Unit V	Axially loaded short and long columns. Uniaxial bending of columns, Isolated footings.	6 lectures

Books:

1. Limit State Design of Reinforced Concrete, 2nd Edition, P C Varghese, Prentice Hall of India, New Delhi, 2002.
2. Reinforced Concrete Design, 2nd Edition, S Unnishrishna Pillai and Davdas Menon, Tata McGraw Hill, New Delhi, 2003.
3. Design of Reinforced Concrete Design, N Subramanian, Oxford University Press, New Delhi, 2013.
4. Limit State Design of Reinforced Concrete, B C Punmia, Ashok K. Jain and Arun K Jain, Laxmi Publications, Delhi, 2007.
5. IS: 456-2000, Code of Practice for Plain and Reinforced Concrete, BIS, New Delhi.
6. SP 16 Design Aids to IS 456 1978, BIS, New Delhi.
7. SP 24 Explanatory Handbook on IS 456 Code of Practice for Plain and Reinforced Concrete, BIS, New Delhi.
8. SP 34 Handbook on Concrete Reinforcement and Detailing, BIS, New Delhi.

CE13203 Water Resources Engineering: 3 Credits (2-0-2)		
Unit I	Hydrological cycle - precipitation, measurement of precipitation, mass curve, hydrograph, point rainfall, depth-area-duration relationships, depth area duration curve, maximum intensity duration frequency curve. evapotranspiration and infiltration.	5 lectures
Unit II	Stream flow measurement, measurement of stage and velocity; Rainfall - runoff characteristics, rainfall runoff correlation, flow duration curve, flow mass curve.	6 lectures
Unit III	Hydrographs - definition, influencing factors and components of a hydrograph, base flow separation, effective rainfall, unit hydrograph, use and limitations.	6 lectures
Unit IV	Groundwater - forms of surface water, aquifer, aquitard, aquiclude, aquifuse; Aquifer properties, specific yield and specific retention, Darcy's law, hydraulic conductivity, transmissibility - steady flow in a well.	6 lectures
Unit V	Crops and crops season; Soil - water relationships, field capacity, consumptive use, requirement and frequency of irrigation; Canal irrigation, Canal outlets. Water logging and Canal lining. River training works.	5 lectures
Books:		
<ol style="list-style-type: none"> 1. Engineering Hydrology, Subramanya, K., Tata McGraw Hill, New Delhi, 2006. 2. Hydrology, Principles, Analysis and Design, Raghunath, H.M., New Age International, New Delhi, 1985. 3. Applied Hydrology, Chow, VT, D R Maidment and L W Mays, McGraw Hill Book Company, New York, 1988. 4. Elementary Hydrology, Singh, V.P., Prentice-Hall India, New Delhi, 1994. 5. A Text Book of Hydrology, Rani Reddi, P.J., Laxmi Publications, New Delhi, 1999. 6. Irrigation and Water Power Engineering. Punmia, B.C. and Pandey, B.B. Lal, Laxmi Publication, Delhi, 1986. 7. Irrigation Engineering, Asawa, G.L., New Age International, New Delhi, 1993. 		

CE12001 Advanced Construction Technology: 3 Credits (3-0-0)		
Unit I	Fibres: Use and properties of steel, polypropylene, carbon and glass fibres. • Plastics: Use and properties of PVC, RPVC, HDPE, FRP, GRP, Miscellaneous Materials: properties and uses of acoustics materials, wall claddings, plaster boards, micro-silica, waterproofing materials, adhesives, use of waste products and industrial by products in bricks, blocks, concrete and mortar.	5 lectures
Unit II	Ready Mix Concrete: Necessity and use of ready mix concrete, products and equipments for ready mix concrete plant, conveying of ready mix concrete, transit mixers, vibrators for concrete consolidation: Internal, needle, surface, platform and form vibrators, underwater concreting: procedure and equipments required for tremie method, drop bucket method, properties, workability and water cement ratio of the concrete, special concrete: procedure and uses of special concretes: Roller compacted concrete, Self-compacting concrete (SCC), Steel fibre reinforced concrete, Foam concrete, shotcreting.	5 lectures
Unit III	Construction of bridges and flyovers: equipments and machineries required for foundation and super structure, construction of multi-storeyed building: equipments and machinery required for construction of multi-storeyed building such as use of lifts, belt conveyers, pumping of concrete, prefabricated construction, methods of prefabrication, plant fabrication and site fabrication, prefabricated building elements such as wall panels, slab panels, beams, columns, door and window frames etc. equipments and machineries used for placing and jointing of prefabricated elements, strengthening of embankments by soil reinforcing techniques using geo-synthetics.	5 lectures
Unit IV	Hoisting equipments: principles and working of Derrick-Pole, Gin Pole, Crane, Power driven scotch derrick crane, hand operated crane, locomotive crane, tower crane, lattice girder, winches, elevators, ladders, crawler cranes, truck mounted cranes, gantry cranes, mast cranes, conveying equipments: working of belt conveyers, types of belts and conveying mechanism, capacity and use of dumpers, tractors and trucks.	5 lectures
Unit V	Excavation equipments: use, working and output of following machinery – bull	8 lectures

	dozers, scrapers, graders, clam shell, trenching equipment, tunnel boring machine, wheel mounted belt loaders, power shovels, JCB, and drag lines, compacting equipments: output of different types of rollers such as plain rollers, ship footed rollers, vibratory, pneumatic rollers rammers, miscellaneous equipments: working and selection of equipments: pile driving equipments, pile hammers, hot mix bitumen plant, bitumen paver, grouting equipment, gunitingequipments, floor polishing and cutting machine selection of drilling pattern for blasting, Bentonite/mud slurry in drilling, explosives for blasting, dynamite, process of using explosives.	
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Books:		
<ol style="list-style-type: none"> 1. Construction Engineering and Management, Sharma S C and Deodhar S V, Khanna Book Publishing, New Delhi 2. Construction Technology Vol. I to II, Chudly, R., ELBS-Longman Group. 3. Construction Planning Equipment and Methods, Peurifoy, R. L., McGraw Hill Co. Ltd. New York. 4. Construction Engineering and Management, Seetharaman, S., Umesh Publication, New Delhi. 5. Construction Management and Planning, Sengupta, B. and Guha., McGraw Hill Education, New Delhi. 6. Materials of Construction, Smith, R. C., McGraw Hill Co. Ltd. 7. Construction Planning and Equipment, Satyanarayana, R Saxena, S. C., Standard Publication, New Delhi. 8. Construction of Structures and Management of works, Rangawala, S. C., Charotar Publication, Anand. 9. Materials of Construction, Ghose, D. N., McGraw Hill Publishing Co, New Delhi. 		

CE12002	Concrete Technology: 3 Credits (2-0-2)	
Unit I	Physical properties of OPC and PPC: fineness, standard consistency, setting time, soundness, compressive strength. Different grades of OPC and relevant BIS codes; Testing of cement: Laboratory tests-fineness, standard consistency, setting time, soundness, compressive strength. Storage of cement and effect of storage on properties of cement; BIS Specifications and field applications of different types of cements: Rapid hardening, Low heat, Portland pozzolana, Sulphate resisting, Blast furnace slag, High Alumina and White cement; Aggregates: Requirements of good aggregate, Classification according to size and shape; Fine aggregates: Properties, size, specific gravity, bulk density, water absorption and bulking, fineness modulus and grading zone of sand, silt content and their specification as per IS 383. Concept of crushed Sand; Coarse aggregates: Properties, size, shape, surface texture, water absorption, soundness, specific gravity and bulk density, fineness modulus of coarse aggregate, grading of coarse aggregates, crushing value, impact value and abrasion value of coarse aggregates with specifications; Water: Quality of water, impurities in mixing water and permissible limits for solids as per IS: 456.	6 lectures
Unit II	Concrete: Different grades of concrete, provisions of IS 456; Duff Abraham water cement (w/c) ratio law, significance of w/c ratio, selection of w/c ratio for different grades, maximum w/c ratio for different grades of concrete for different exposure conditions as per IS 456; Properties of fresh concrete: Workability: Factors affecting workability of concrete. Determination of workability of concrete by slump cone, compaction factor, Vee-Bee Consistometer. Value of workability requirement for different types of concrete works. Segregation, bleeding and preventive measures; Properties of Hardened concrete: Strength, Durability, Impermeability.	6 lectures
Unit III	Concrete mix design: Objectives, methods of mix design, study of mix design as per IS 10262 (only procedural steps); Testing of concrete, determination of compressive strength of concrete cubes at different ages, interpretation and co-relation of test results; Non-destructive testing of concrete: Rebound hammer test, working principle of rebound hammer and factor affecting the rebound index, Ultrasonic pulse velocity test as per IS13311 (part 1 and 2), Importance of NDT tests.	5 lectures
Unit IV	Quality Control of Concrete, Concreting Operations: Batching, Mixing,	5 lectures

	Transportation, Placing, Compaction, Curing and Finishing of concrete. • Forms for concreting: Different types of form works for beams, slabs, columns, materials used for form work, requirement of good form work. Stripping time for removal of form works per IS 456; Waterproofing: Importance and need of waterproofing, methods of waterproofing and materials used for waterproofing; Joints in concrete construction: Types of joints, methods for joining old and new concrete, materials used for filling joints.	
Unit V	Chemical Admixture, Special Concrete and Extreme Weather concreting; Admixtures in concrete: Purpose, properties and application for different types of admixture such as accelerating admixtures, retarding admixtures, water reducing admixtures, air entraining admixtures and super plasticizers; Special Concrete: Properties, advantages and limitation of following types of Special concrete: Ready mix Concrete, Fiber Reinforced Concrete, High performance Concrete Self-compacting concrete and light weight concrete; Cold weather concreting: effect of cold weather on concrete, precautions to be taken while concreting in cold weather condition; Hot weather concreting: effect of hot weather on concrete, precautions to be taken while concreting in hot weather condition.	6 lectures

Books:

1. Concrete Technology (5e), Gambhir, M.L., Tata McGraw Hill Publishing Co. Ltd., Delhi, 2017.
2. Concrete Technology, Shetty, M.S., S. Chand and Co. Pvt. Ltd., Ram Nagar, Delhi, 2006.
3. Concrete Technology, Santhakumar, A. R., Oxford University Press, New Delhi, 2018.
4. Concrete: Microstructure, Properties and Materials, P. K. Mehta and Paulo J. M. Monterio, McGraw Hill Education, 2017.
5. Concrete Technology (2e), Neville, A. M. and Brooks, J.J., Pearson Education Pvt. Ltd, 2019.
6. Concrete Technology, Neville, A. M., Pearson Education Pvt. Ltd., New Delhi.
7. Laboratory Manual in Concrete Technology, Sood, H., Kulkarni P. D., Mittal L. N., CBS Publishers, New Delhi.

CE12003 Precast and Prestressed Concrete: 3 Credits (3-0-0)		
Unit I	Advantages and disadvantages of precast concrete members; Non-structural Precast elements - Paver blocks, Fencing Poles, Transmission Poles, Manhole Covers, Hollow and Solid Blocks, kerb stones as per relevant BIS specifications; Structural Precast elements – tunnel linings, Canal lining, Box culvert, bridge panels, foundation, sheet piles; Testing of Precast components as per BIS standards.	7 lectures
Unit II	Precast Structural Building components such as slab panels, beams, columns, footings, walls, lintels and chajjas, staircase elements; Prefabricated building using precast load bearing and non load bearing wall panels, floor systems - Material characteristics, Plans & Standard specifications; Modular co-ordination, modular grid, and finishes; Prefab systems and structural schemes and their classification including design considerations; Joints – requirements of structural joints and their design considerations; Manufacturing, storage, curing, transportation and erection of above elements, equipment needed.	7 lectures
Unit III	Principles of pre-stressed concrete and basic terminology; Applications, advantages and disadvantages of prestressed concrete; Materials used and their properties, Necessity of high-grade materials; Types of Pre-stressing steel -Wire, Cable, tendon, Merits-demerits and applications.	6 lectures
Unit IV	Methods of prestressing – Internal and External pre-stressing, Pre and Post tensioning- applications; Systems for pre tensioning – process, applications, merits and demerits - Hoyer system; Systems for post-tensioning - process, applications, merits and demerits - Freyssinet system, Magnel Blaton system, Gifford Udall system; Prestressing force in Cable, Loss of prestress during the tensioning process - loss due to friction, length effect, wobbling effect and curvature effect, (Simple Numerical problems to determine loss of pre-stress),	10 lectures

	Loss of pre-stress at the anchoring stage; Loss of pre-stress occurring subsequently: losses due to shrinkage of concrete, creep of concrete, elastic shortening, and creep in steel, (Simple Numerical problems to determine loss of pre-stress); BIS recommendations for percentage loss in case of Pre and Post tensioning.	
Unit V	Basic assumptions in analysis of pre-stressed concrete beams; Cable Profile in simply supported rectangular beam section – concentric, eccentric straight and parabolic; Effect of cable profile on maximum stresses at mid span and at support; Numerical problems on determination of maximum stresses at mid spans with linear (concentric and eccentric) cable profiles only; Simple steps involved in Design of simply supported rectangular beam section (No numerical problems).	12 lectures

Books

1. Pre-stressed Concrete, Krishna Raju, N., Tata McGraw Hill, New Delhi.
2. Prestressed Concrete, Shrikant B. Vanakudre, Khanna Publishing House, New Delhi.
3. Pre Cast and Pre Stress Technology: Process, Method and Future Technology, Marzuki, Nor Ashikin, Createspace Independent Publication.
4. Handbook on Precast Concrete buildings. Indian Concrete Institute.
5. Elliott, Kim S., Precast Concrete Structures, CRC Press, New York.
6. Design of Pre-Stressed Concrete Structures, Lin, T.Y., John Wiley and Sons, New York.
7. Pre-stressed Concrete Structures, Nagarajan, Pravin., Pearson Education India.
8. IS 12592 Precast Concrete Manhole Cover and Frame, BIS, New Delhi 8. BIS, New Delhi. IS 15658 Precast concrete blocks for paving - Code of Practice, BIS, New Delhi 9. BIS, New Delhi.
9. IS 15916 Building Design and Erection Using Prefabricated Concrete - Code of Practice, BIS, New Delhi.
10. IS 15917 Building Design and Erection Using Mixed/Composite Construction - Code of Practice, BIS, New Delhi.
11. IS 458 Precast Concrete Pipes (with and without reinforcement) – Specification, BIS, New Delhi

CE12004 Rural Construction Technology: 3 Credits (3-0-0)		
Unit I	Scope; development plans; various approaches to rural development planning; Significance of rural development; Rural development programme / projects.	4 lectures
Unit II	Low cost construction material for housing; Composite material- ferro-cement & fly ash, autoclaved calcium silicate bricks and soil-stabilized un-burnt brick; Plinth protection of mud walls; Water-proof and fire-retardant roof treatment for thatch roofs. Pre-cast stone masonry, rattrap bond for walls; Panels for roof, ferro-cement flooring/roofing units; Biomass - types of fuels such as firewood, agricultural residues, dung cakes; Renewable energy and integrated rural energy program - Objectives, Key elements, Implementation, Financial provisions, sources of renewable energy; Working of gobar gas and bio gas plants.	10 lectures
Unit III	Sources of water: BIS & WHO water standards; Quality, Storage and distribution for rural water supply works; Hand pumps-types, installation, operation, and maintenance of hand pumps; Conservation of water - rainwater harvesting, drainage in rural areas; Construction of low cost latrines: Two pit pour flush water seal, septic tank etc.; Low cost community and individual Garbage disposal systems, Ferro-cement storage tanks.	6 lectures
Unit IV	Broad categories of Pavement Layers, types of Granular Sub-Bases and Bases; Guidelines for Surfacing of Rural Road as per relevant IRC codes; Pradhan Mantri Gram Sadak Yojna (PMGSY)- Highlights of Scheme.	10 lectures
Unit V	Design consideration and construction of tube-well, drip & sprinkler irrigation systems; Watershed and catchment area development –problems and features of watershed management; Watershed management structures - K. T. weir, Gabian Structure, Cement Plug, Contour Bunding, Farm pond, Bandhara system.	12 lectures
Books:		
1. Appropriate Technologies for Low Cost Housing, Madhov Rao A G, and Ramachandra Murthy, D S, Oxford and IBH Publishing Co. Pvt. Ltd.		

2. Advances in Building Materials and Constriction, CBRI, Roorkee.
3. Rural Development in India: Past, Present and Future: A Challenge in the Crisis, Desai,Vasant, Himalaya Publishing House, Delhi.
4. Rural Development Strategy, Rastogi, A.K., Wide Vision, Jaipur.
5. Rural Development Principles, Policies and Management, Singh, Katar, Sage Publications India Pvt Ltd.
6. Dynamics of Rural Development, Gaur, Keshav Dev, Mittal Publications, Delhi.
7. Document Published by Ministry of Rural development, Govt. of India, Ministry of Rural development.

CE13001	Traffic Engineering: 3 Credits (3-0-0)	
Unit I	Traffic engineering- Definition, objects, scope; Relationship between speed, volume and density of traffic; Road user's characteristics-physical, mental, emotional factors; Vehicular characteristics-width, length, height, weight, speed, efficiency of breaks; Road characteristics - gradient, curve of a road, design speed, friction between road and tyre surface; Reaction time - factors affecting reaction time. PIEV Theory.	7 lectures
Unit II	Traffic volume count data- representation and analysis of data, Necessity of Origin and Destination study and its methods, Speed studies - Spot speed studies, and its presentation; Need and method of parking study.	7 lectures
Unit III	Traffic control devices –definition, necessity, types, Road signs - definition, objects of road signs; Classification as per IRC: 67-Mandatory or Regulatory, Cautionary or warning, informatory signs, Location of cautionary or warning sign in urban and non-urban areas, Points to be considered while designing and erecting road signs; Traffic markings- definition, classification, carriage way, kerb, object marking and reflector markers.	6 lectures
Unit IV	Traffic signals- Definition, Types, Traffic control signals, pedestrian signals; Types of traffic control signals - Fixed time, manually operated, traffic actuated signals and location of signals; Compute signal time by fix time cycle, Webster's and IRC method and sketch timing diagram for each phase; Traffic islands –Definition, advantages and disadvantages of providing islands; Types of traffic islands - rotary or central, channelizing or Refuge Island; Road intersections or junctions - Definition, Types of road intersection; Intersection at grade- Types, basic requirements of good intersection at grade; Grade separated intersection-advantages and disadvantages, types - flyovers-partial and full Cloverleaf pattern, Diamond intersection, Trumpet type, underpass.	10 lectures
Unit V	Road Accidents-Definition, types and causes for collision and non-collision accidents; Measures to prevent road accidents; Collision and condition diagram; Street lighting –definition, necessity, types-luminaire, foot candle, lumen, factors affecting their utilization and maintenance; Arboriculture- definition, objectives, factors affecting selection of type of trees; Maintenance of trees-protection and care of road side trees.	12 lectures

Books:

1. Highway Engineering, Khanna S.K., Justo, C E G and Veeraragavan, A., Nem Chand and Brothers, Roorkee. Transportation Engineering, Kadiyali L.R., Khanna Book Publishing Co., Delhi
2. Transportation Engineering Vol. I & II, Vazirani, V N, Chaondola, S P, Khanna Publishers. Delhi.
3. Traffic planning and design, Saxena, S C, Dhanpat Rai & Sons Delhi.
4. Introduction to Traffic Engineering, Kumar R S, University Press (India), Pvt. Ltd.

CE13002	Solid Waste Management: 3 Credits (3-0-0)	
Unit I	Definition of solid waste, different solid waste – domestic Waste, commercial waste, industrial waste, market waste, agricultural waste, biomedical waste, E-waste, hazardous waste, institutional waste, etc.; Sources of solid waste, Classification of solid waste – hazardous and non- hazardous waste; Physical and chemical characteristics of municipal solid waste.	8 lectures
Unit II	Collection, segregation, storage and transportation of solid waste; Tools and Equipment-Litter Bin, Broom, Shovels, Handcarts, Mechanical road sweepers, Community bin - like movable and stationary bin; Transportation vehicles with their	8 lectures

	working capacity -Animal carts, Auto vehicles, Tractors or Trailers, Trucks, Dumpers, Compactor vehicles. Transfer station- meaning, necessity, location; Role of rag pickers and their utility for society.	
Unit III	Concept of composting of waste, Principles of composting process. Factors affecting the composting process; Methods of composting – Manual Composting – Bangalore method, Indore Method, Mechanical Composting – Dano Process, Vermi composting.	6 lectures
Unit IV	Solid waste management techniques – solid waste management hierarchy, waste prevention and waste reduction techniques; Land filling technique, Factors to be considered for site selection, Land filling methods-Area method, Trench method and Ramp method, Leachate and its control, Biogas from landfill, Advantages and disadvantages of landfill method, Recycling of municipal solid waste; Incineration of waste: Introduction of incineration process, Types of incinerators - Flash, Multiple chamber Incinerators, Products of incineration process with their use, Pyrolysis of waste – Definition, Methods.	12 lectures
Unit V	Definition of Bio medical Waste; Sources and generation of Biomedical Waste and its classification; Bio medical waste Management technologies; Definition, varieties and ill effects of E- waste; Recycling and disposal of E- waste.	8 lectures

Books:

1. Elements of Solid Hazardous Waste Management, Gupta O.P., Khanna Book Publishing Co., Delhi Ed. 2018
2. Solid Waste Management, Bhide, A. D., Indian National Scientific Documentation Centre, New Delhi.
3. Solid Waste, George Tchobanoglous, Kreith, Frank., McGraw Hill Publication, New Delhi.
4. Solid Waste Management, Sasikumar, K., PHI learning, Delhi.
5. Prospect and Perspectives of Solid Waste Management, Hosetti, B.B., New Age International Publisher.

CE13003	Surveying & Geomatics: 3 Credits (2-0-2)	
Unit I	Triangulation system, strength of figures, selection and inter-visibility of stations, signals & towers, base line measurement, reduction to mean sea level, satellite stations, reduction to centre.	5 lectures
Unit II	Theory of errors and triangulation adjustments- types of errors, principle of least squares, laws of weights, normal equations, method of correlates, station and figure adjustments.	5 lectures
Unit III	Photogrammetry- definition & scope, branches of photogrammetry, photogrammetric methods, stereo-pairs, relief displacement and tilt distortion, flight planning, ground control, plotting instruments.	5 lectures
Unit IV	Astronomical survey- terms and definitions, formula of spherical trigonometry, methods used culmination of stars, circumpolar stars, measurement of times and their conversions, instruments used; Related practice.	5 lectures
Unit V	Principle of Electronic Distance Meter (EDM), its component parts and their Functions, use of EDM. • Use of micro-optic Theodolite and Electronic Digital Theodolite. • Use of Total Station, Use of function keys. • Measurements of Horizontal angles, vertical angles, distances and coordinates using Total Station, Traversing, Profile Survey and Contouring with Total Station. Remote sensing, GPS and GIS • Remote Sensing – Overview, Remote sensing system, Applications of remote sensing in Civil engineering, land use / Land cover, mapping, disaster management. • Use of Global Positioning System (G.P.S.) instruments. • Geographic Information System (GIS): Overview, Components, Applications, Software for GIS. • Introduction to Drone Surveying.	8 lectures

Books:

1. Surveying Vol. II & III, B.C. Punamia, Laxmi Publication, New Delhi, 1994.
2. Surveying & Levelling Vol. II, T.P. Kanetkar & S.V. Kulkarni, Pune Vidyarthi GrihaPrakashan, Pune, 1985.
3. Surveying Vol. II, S.K. Duggal, Tata McGraw Hill, New Delhi, 1996.
4. Plane & Geodetic Surveying for Engineers Vol. II, David Clark, C.B.S., New Delhi, 1983.
5. A Text Book of Advanced Surveying, R. Agor, Khanna Publishers, Delhi, 1994.
6. Surveying, A. Barmister & S. Raymond, Longman, English Language Book Society, London, 1984.
7. Surveying and Levelling, Basak, N. N., McGraw Hill Education (India) Pvt. Ltd., Noida.

8. Survey I and Survey II, Duggal, S. K., Tata McGraw Hill Education Pvt. Ltd., Noida.
9. Surveying, Saikia, M D.; Das. B.M.; Das. M.M., PHI Learning Pvt. Ltd., New Delhi.
10. Surveying and Levelling, Subramanian, R., Oxford University Press. New Delhi.
11. Textbook of Surveying, Rao, P. Venugopala Akella, Vijayalakshmi, PHI Learning Pvt. Ltd., New Delhi.
12. Textbook of Surveying, Venkatramaiah, C, Universities Press, Hyderabad.
13. Surveying theory and practice, Anderson, James M and Mikhail, Edward M, Mc Graw Hill Education, Noida.
14. Plane Surveying, De, Alak, S.Chand Publications, New Delhi.

CE13011	Green Building and Energy Conservation: 3 Credits (3-0-0)	
Unit I	Definition of Green Building, Benefits of Green building, Components/features of Green Building, Site selection, Energy Efficiency, Water efficiency, Material Efficiency, Indoor Air Quality; Site selection strategies, Landscaping, building form, orientation, building envelope and fenestration, material and construction techniques, roofs, walls, fenestration and shaded finishes, advanced passive heating and cooling techniques, waste reduction during construction.	7 lectures
Unit II	Energy Audit: Meaning, Necessity, Procedures, Types, Energy Management Programs; Environmental Impact Assessment(EIA): Introduction, EIA regulations, Steps in environmental impact assessment process, Benefits of EIA, Limitations of EIA, Environmental clearance for the civil engineering projects.	7 lectures
Unit III	Renewable Energy Resources: Solar Energy, Wind Energy, Ocean Energy, Hydro Energy, Biomass Energy; Non-renewable Energy Resources: Coal, Petroleum, Natural Gas, Nuclear Energy, Chemical Sources of Energy, Fuel Cells, Hydrogen, Biofuels; Energy conservation: Introduction, Specific objectives, present scenario, Need of energy conservation, LEED India Rating System and Energy Efficiency.	6 lectures
Unit IV	Introduction: Definition of Green building, Benefits of Green building; Principles: Principles and planning of green building; Features: Salient features of Green Building, Environmental design (ED) strategies for building construction; Process: Improvement in environmental quality in civil structure; Materials: Green building materials and products- Bamboo, Rice husk ash concrete, plastic bricks, Bagasse particle board, Insulated concrete forms. reuse of waste material-Plastic, rubber, Newspaper wood, Nontoxic paint, green roofing.	10 lectures
Unit V	Introduction to (LEED) criteria; Indian Green Building council (IGBC) Green rating; Green Rating for Integrated Habitat Assessment. (GRIHA) criteria; Heating Ventilation Air Conditioning (HVAC) unit in green Building; Functions of Government organization working for Energy conservation and Audit(ECA); National Productivity council(NPC) • Ministry of New and Renewable Energy (MNRE); Bureau of Energy efficiency (BEE)	12 lectures

Books:

1. Sustainable construction: Green Building design and Delivery, Kibert, C.J., John Wiley Hobo-u ken, New Jersey.
2. Non-conventional Energy Resources, Chauhan, D S Sreevasthava, S K., New Age International Publishers, New Delhi.
3. Energy Technology, O.P. Gupta, Khanna Publishing House, New Delhi.
4. Alternative Building Materials and Technologies, Jagadeesh, K S, Reddy Venkatta Rama & Nanjunda Rao, K S., New Age International Publishers, Delhi.
5. Handbook of Green Building Design and Construction, Sam Kubba., Butterworth-Heinemann.
6. Means R S, Green Building - Project Planning and Cost Estimating, John Wiley & Sons.
7. Energy Management and Conservation, Sharma K V, Venkataseshaiyah P., IK International.

CE13012	Energy Science and Engineering: 3 Credits (3-0-0)	
Unit I	Introduction to Energy Science: Scientific principles and historical interpretation to place energy use in the context of pressing societal, environmental and climate issues; Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment.	5 lectures
Unit II	Energy Sources: Overview of energy systems, sources, transformations, efficiency, and storage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind,	5 lectures

	solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energy storages, high efficiency batteries).	
Unit III	Energy & Environment:Energy efficiency and conservation; introduction to cleanenergy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How future energy use can be influenced by economic, environmental, trade, and research policy.	5 lectures
Unit IV	Civil Engineering Projects connected with the Energy Sources:Coal miningtechnologies, Oil exploration offshore platforms, Underground and under-sea oil pipelines, solar chimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydro power stations above-ground and underground along with associated dams, tunnels, penstocks, etc.; Nuclear reactor containment buildings and associated buildings, design and construction constraints and testing procedures for reactor containment buildings; Spent Nuclear fuel storage and disposal systems.	5 lectures
Unit V	Engineering for Energy conservation:Concept of Green Building and Green Architecture; Green building concepts (Green building encompasses everything from the choice of building materials to where a building is located, how it is designed and operated); <i>LEED ratings</i> ; Identification of energy related enterprises that represent the breath of theindustry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption.	8 lectures
Books: <ol style="list-style-type: none"> 1. Renewable Energy (2nd edition), Boyle Godfrey, Oxford University Press, 2004. 2. Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press 3. The Complete Guide to Renewable Energy Technologies and Sustainable Living, Schaeffer, John Real Goods Solar Gaiam. 2007. 4. Energy and Environment Set: Mathematics of Decision Making, Jean-Philippe; Zaccour, Georges (Eds.), Loulou, Richard; Waaub, XVIII, 2005. 5. Energy and the Environment, 2nd Edition, Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A. John Wiley, 2006. 6. UNDP (2000), Energy and the Challenge of Sustainability, World Energy assessment 7. Energy & Environment: A Primer for Scientists and Engineers, E H Thorndike Addison-Wesley Publishing Company, 1976. 		

CE13013	Pavement Design andMaintenance: 3 Credits (3-0-0)	
Unit I	Types of pavements - Flexible, Rigid and Semi Rigid; Comparison of Rigid and flexible pavement according to Design precision, life maintenance, initial cost, stages of construction, availability of materials, surface characteristic, penetration of water in the pavement, utility location, glare and night visibility; Functions and characteristics of pavement; Factors affecting selection of type of pavement.	7 lectures
Unit II	Factors affecting pavement design-design wheel load,Traffic factors, Environmental factors, Road geometry and material, Characteristics of soil and Drainage situation.	7 lectures
Unit III	Methods of flexible pavement design-Theoretical method, Empirical method with and without soil strength test; IRC37 guidelines for design of flexible pavement (overview only) • Factors affecting design of concrete pavement; IRC58 guidelines for design of concrete pavement (overview only); Joints-Need, Types, requirements, spacing of joints.	6 lectures
Unit IV	Definition and purpose of pavement evaluation; Methods of Pavement evaluation –Visual rating, Pavement serviceability index, Roughness measurements, Benkelman Beam deflection method.	10 lectures
Unit V	Types of pavement maintenance - routine, periodic, and special. Need for inspection and maintenance schedule. Causes of pavement failure and remedial	12 lectures

	measures. Typical flexible and rigid pavement failures; Types and causes of damages in flexible pavement, surface defects, cracks. Deformations - Rutting, fatigue, settlement and upheaval. Disintegration- loss of aggregate, stripping, pothole. Remedial measures - slurry seal, liquid seal, fog seal, patching, ready mix patch; Types of damages to rigid pavement - cracking, spalling, slab rocking, settlement, joint sealant failure. Methods of repair - repair of spalled joints, full depth reconstruction, replacement of dowel bars.	
Books:		
<ol style="list-style-type: none"> 1. Highway Engineering, Kadiyali, L.R., Khanna Book Publishing House, New Delhi (ISBN: 978-93-86173-133). 2. Principles of Transportation engineering, Chakroborty, Partha Das, Animesh., Prentice-Hall of India Pvt.Ltd. 3. Transportation Engineering Vol. I & II, Vazirani, V N, Chaondola, S P., Khanna Publishers, Delhi. 4. Principles of Pavement Design, Yoder, E J, Wiley India Pvt Ltd. 5. Bindra, S P., Highway Engineering, Dhanpat Rai Publications (P) Ltd. 5. Kumar R S, Pavement Evaluation and Maintenance Management system, University Press (India), Pvt. Ltd. 6. Sharma S K, Principles, Practice and Design of Highway Engineering, S Chand, New Delhi. 		

CE13014 Building Services and Maintenance: 3 Credits (3-0-0)		
Unit I	Introduction to building services, Classification of buildings as per National Building code, Necessity of building services, Functional requirements of building, Different types of building services i.e. HVAC (Heat, Ventilation and Air Conditioning), Escalators and lifts, fire safety, protection and control, plumbing services, rain water harvesting, solar water heating system, lighting, acoustics, sound insulation and electric installation etc.; Role and responsibility of Building Service Engineer, Introduction to BMS (Building Management Services), Role of BMS, concept of smart building.	7 lectures
Unit II	Objectives and modes of vertical communication in building; Lifts: Different types of lifts and its uses, Component parts of Lift- Lift Well, Travel, Pit, Hoist Way, Machine, Buffer, Door Locks, Suspended Rope, Lift Car, Landing Door, Call Indicators, Call Push etc., Design provisions for basic size calculation of space enclosure to accommodate lift services, Safety measures; Escalators: Different Types of Escalators and its Uses, Components of escalators, Design provisions for basic size calculation of space enclosure to accommodate escalator services, Safety measures; Objectives and modes of vertical communication in building. Lifts: Different types of lifts and its uses, Component parts of Lift- Lift Well, Travel, Pit, Hoist Way, Machine, Buffer, Door Locks, Suspended Rope, Lift Car, Landing Door, Call Indicators, Call Push etc., Design provisions for basic size calculation of space enclosure to accommodate lift services, Safety measures. Escalators: Different Types of Escalators and its Uses, Components of escalators, Design provisions for basic size calculation of space enclosure to accommodate escalator services, Safety measures. Ramp: Necessity, design consideration, gradient calculation, layout and Special features required for physically handicapped and elderly. Ramp: Necessity, design consideration, gradient calculation, layout and Special features required for physically handicapped and elderly.	7 lectures
Unit III	Fire protection requirements for multi-storeyed building, causes of fire in building, Fire detecting and various extinguishing systems, Working principles of various fire protection systems; Safety against fire in residential and public buildings (multi-storeyed building), National Building Code provision for fire safety, Fire resisting materials and their properties, Fire resistant construction, procedures for carrying out fire safety inspections of existing buildings, Provisions for evacuation.	6 lectures
Unit IV	Importance of plumbing, AHJ (Authority Having Jurisdiction) approval, Plumbing Terminology and fixtures: Terms used in plumbing, Different types of plumbing fixtures, shapes/ sizes, capacities, situation and usage, Traps, Interceptors; System of plumbing for building water supply: storage of water, hot and cold water supply system; System of plumbing for building drainage: Types of drainage system such as two pipe system, one pipe system, types of Vents and purpose of venting, Concept of grey water and reclaimed water; Different pipe materials, and jointing methods, fittings, hanger, supports and valves used in plumbing and their suitability.	10 lectures
Unit V	Concept of SWH (Solar water heating), component parts of SWH, various system of	12 lectures

	SWH (heat transfer, propulsion, passive direct system, active direct system, Do-it-yourself), installation and maintenance; Concept of lighting, types of lighting (natural and artificial), factors influencing the brightness of room, factors affecting selection of artificial lighting, installation of light (direct, half-direct, indirect, half-indirect and direct-indirect), types of light control (manual switch, remote switch, timer switch and photo-electric cell switch), types of lamps (incandescent, tungsten halogen and electric discharge), Lamp selection as per room sizes; Concept of ventilation, necessity and Types of ventilation; Building Acoustic, Objectives, acoustic Control in a building, acoustic material (porous absorber and cavity resonator)	
Books:		
<ol style="list-style-type: none"> 1. Building Services, Patil, S. M., Seema Publication, Mumbai. 2. The A to Z of Practical Building Construction and its Management, Mantri and Sandeep, Satya Prakashan, New Delhi. 3. Fire Services in India: History, Detection, Protection, Management, Bag S P, Mittal Publications, New Delhi. 4. Plumbing Design and Practice, Deolalikar, S. G., McGraw-Hill. 5. Principles of Fire Safety Engineering: Understanding Fire and Fire Protection, Akhil Kumar Das., PHI Learning Pvt. Ltd, New Delhi. 6. Solar panel installation guide & user manual, Shraman N L, The Memory Guru of India. 7. Practical handbook on building maintenance - Civil works, Gupta M K, Nabhi Publications. 8. BIS., National Building Code Part1, 4, 8, 9., Bureau of Indian Standard, New Delhi. 9. BIS., IS 12183 (Part 1):1987 Code of practice for plumbing in multistoried buildings., Bureau of Indian Standard, New Delhi. 10. BIS., 2008 Uniform plumbing code – India (UPC-I), Bureau of Indian Standard. 		

CE13021 Repairs and Maintenance of Structures: 3 Credits (3-0-0)		
Unit I	Types of Maintenances - repair, retrofitting, re-strengthening, rehabilitation and restoration; Necessity, objectives and importance of maintenance; Approach of effective management for maintenance; Periodical maintenance: check list, maintenance manual containing building plan, reinforcement details, material sources, maintenance frequency, corrective maintenance procedures and sources. Pre- and post- monsoon maintenance.	8 lectures
Unit II	Causes of damages due to distress, earthquake, wind, flood, dampness, corrosion, fire, deterioration, termites, pollution and foundation settlement; Various aspects of visual observations for detection of damages; Load test and non-destructive tests (brief description). NDT tests on damaged structure such as rebound hammer, ultrasonic pulse velocity, rebar locator, crack detection microscope, digital crack measuring gauge; Chemical test – Chloridetest, sulphate attack, carbonation test, pH measurement, resistivity method, Half-cell potential meter (Introduction and demonstration only)	8 lectures
Unit III	Types of repair material, material selection; Essential parameters for maintenance and repair materials such - bond with substrate, durability; Waterproofing materials based on polymer modified cement slurry, UV resistant acrylic polymer, ferro-cement; Repairing materials for masonry: plastic/aluminum nipples, non-shrink cement, polyester putty or 1:3 cement sand mortar, galvanized steel wire fabrics and clamping rods, wire nails, ferro-cement plates; Repairing materials for RCC: epoxy resins, epoxy mortar, cement mortar impregnated with polypropylene, silicon, polymer concrete composites, sealants, fiber reinforcement concrete, emulsions and paints.	8 lectures
Unit IV	Causes of cracks in walls - bulging of wall, shrinkage, bonding, shear, tensile, vegetation; Probable crack location: junction of main and cross wall, junction of slab and wall, cracks in masonry joints; methods based on crack type - For minor & medium cracks (width 0.5 mm to 5mm): grouting and for major cracks (width more than 5mm): fixing mesh across cracks, RCC band, installing ferro-cement plates at corners, dowel bars, propping of load bearing; Remedial measures for dampness & efflorescence in wall.	8 lectures
Unit V	Repair stages such as concrete removal and surface preparation, fixing suitable formwork, bonding/passive coat and repair application, various methods of surface preparation; Repair options such as grouting, patch repairs, carbonated concrete, cleaning the corroded steel, concrete overlays, latex concrete, epoxy bonded mortar	10 lectures

	and concrete, polymer concrete, corrosion protection such as jacketing.; Building cracks and its prevention, common methods for dormant crack repairs such as Epoxy injection, grooving and sealing, stitching, grouting and guniting/ shotcreting; Strengthening methods for live cracks such as addition of reinforcements, Jacketing, brackets, collars, supplementary members i.e. shoring, underpinning and propping of framed structure.	
Books:		
<ol style="list-style-type: none"> 1. Building Repair and Maintenance Management, Gahlot, P. S., Sharma, S., CBS Publishers & Distributors Pvt. Ltd., New Delhi. 2. Maintenance and Repairs of Buildings, Guha, P. K., New Central Book Agencies. 3. Maintenance and Repairs of Buildings, Hutchin Son, B. D., Newnes-Butterworth. 4. Relevant BIS codes. 		

CE13022	Advanced Design of Structures: 3 Credits (3-0-0)	
Unit I	Types of rivets, Riveted connections, Strength of riveted joints, Design of riveted joints for axially loaded members; Types of welds, welded connections, Permissible stresses in weld, Strength of weld. Advantages and disadvantages of weld, Design of fillet weld and butt weld for axial load; Design of column bases for axially loaded columns only.	7 lectures
Unit II	Different steel sections, Simple and built-up sections, Permissible bending stresses, • Design of built-up sections (symmetrical I section with cover plates only), check for shear and deflection; Introduction to plate girder: Components and functions.	7 lectures
Unit III	General features of T and L beams, Advantages, Effective width as per BIS 456; Design of singly reinforcement T beam, Stress and Strain diagram, Depth of neutral axis, Moment of resistance, T and L beams with neutral axis in flange only; Simple numericals on location of neutral axis, Effective width of flange.	6 lectures
Unit IV	Design of simply supported one-way slab for flexure, shear and deflection and checks, as per the provisions of BIS 456; Design of one-way cantilever slab, Chajjas, Flexure including checks for Development length and Shear stress; Design of two-way simply supported slab; Introduction to design of dog-legged staircases.	10 lectures
Unit V	IS 456 provisions, Column with uni-axial and bi-axial moments, Effective length calculations, Minimum eccentricity; Design of footing for axially loaded column only.	12 lectures
Books:		
<ol style="list-style-type: none"> 1. Limit State Design of Steel Structures, Shah, V. L., and Gore, V., Structures Publications, Pune. 2. Design of Steel Structures, Dayarathnam, P., S. Chand and Company, New Delhi. 3. Design of Steel Structures, Subramanian N., Oxford University Press. 4. Design of Steel Structures, Sairam, K.S., Pearson Publication, Chennai, Delhi. 5. Limit State Theory and Design of Reinforced Concrete Structures, Shah, V. L., and Karve, S.R., Structures Publications, Pune. 6. Fundamentals of Reinforced Concrete, Sinha N.C., and Roy S.K., S. Chand & Co. 7. Reinforced Concrete Design Principles and Practice, Krishna Raju, New Age International, Mumbai. 8. Reinforced concrete Design, Pillai, S.U., and Menon, Devdas, McGraw Hill. 8. Limit State Design of Reinforced Concrete, Varghese, P. C., Prentice Hall India Learning Private Limited, Delhi. 		

CE13023	Tendering and Accounts: 3 Credits (3-0-0)	
Unit I	Administrative approval, technical sanction, budget provision, expenditure sanction. Methods for carrying out works- contract method, departmental method -rate list method, piece work method, day's work method, employing labours on daily wages basis.	7 lectures
Unit II	Definition of contract, objects of contract, requirements of contract, overview of Indian Contract Act; Types of engineering contract with advantages, disadvantages and their suitability – Lumpsum contract, item rate contract, percentage rate contract, cost plus percentage, cost plus fixed fee, cost plus variable percentage and cost plus variable fee contract, labour contract, demolition contract, target contract, negotiated contract, Engineering Procurement Construction Contract (EPC), Annuity Contract; Introduction of FIDIC Conditions of contract; Classification of contractor on basis of financial limits, Requirement of documents for registration of contractor; Build Operate Transfer (BOT) Project, BOT Toll contract, BOT	7 lectures

	(Annuity) contract, Design, Build, Finance, Operate and Transfer (DBFOT) contract, Hybrid Annuity contract, Operate Maintain and Transfer (OMT) contract, Operation & Maintenance contract (Introduction only).	
Unit III	Definition of tender, necessity of tender, types of tender- Local, Global, Limited; E - Tendering System – Online procedure of submission and opening of bids (Technical and Financial); Notice to invite tender (NIT)- Points to be included while drafting tender notice, Drafting of tender notice; Procedure of submitting filled tender Documents (Two envelope system), procedure of opening tender, comparative statement, scrutiny of tenders, award of contract, letter of award; Meaning of terms - Earnest Money Deposit (EMD), Performance Security Deposit, Validity period, corrigendum to tender notice and its necessity, Unbalanced bid; Tender documents – Index, tender notice, general instructions, special instructions, Schedule A, Schedule B, Schedule C etc.; Terms related to tender documents – contract conditions- time limit, time extension, penalty, defective material and workmanship, termination of contract, suspension of work, subletting of contract, extra items, price variation clause(escalation), defect liability Period, liquidated Damages; Arbitration-Meaning, Qualification of an arbitrator, Appointment, Dispute and Settlement of disputes, Arbitration and Conciliation Act, Arbitration award.	6 lectures
Unit IV	Various account forms and their uses – Measurement Books, E- Measurement book (E-MB), Nominal Muster Roll(NMR), Imprest Cash, Indent, Invoice, Bill, Vouchers, Hand receipt Cash Book, Temporary Advance. Heads of Accounts; Mode of Payment to the contractor and its necessity -Interim Payment, Advance Payment Secured Advance, Petty advance, Mobilization advance, Running account bill, Final bill, Retention money, E - payment.	10 lectures
Unit V	Definition and purpose of Valuation, role of valuer. Definition - Cost, Price and Value, Characteristics of Value, Factors Affecting Value; Types of Value - Book Value, Scrap Value, Salvage Value, Speculative Value, Distress Value, Market Value, monopoly Value, Sentimental Value. Factors affecting value; Depreciation, Obsolescence, Sinking Fund, Methods of Calculation of Depreciation – Straight Line Method, Sinking Fund Method, Constant Percentage Method; Fixation of rent, Lease – types of leases, lease hold property and free hold property. Mortgage – Mortgage deed, precautions to be taken while making mortgage.	12 lectures
Books:		
<ol style="list-style-type: none"> 1. Estimating and Costing in Civil engineering, Datta, B. N., UBS Publishers Pvt. Ltd., New Delhi. 2. Construction Management and Contract Practices, Raina, V. K., Shroff Publishers & Distributers Pvt. Ltd. 3. Estimating and Costing, Rangawala, S. C., Charotar Publishing House PVT. LTD., Gujrat. 4. Estimating and Costing, Birdie, G. S., Dhanpat Rai Publishing Company(P) Ltd., New Delhi. 5. Civil Engineering Contracts and Estimates, Patil, B. S., Orient Longman, Mumbai. 6. Estimating and Costing, Specification and Valuation in Civil Engineering, published by author, (Monojit Chakraborti) Kolkata. 		

CE13041	Biological Waste Water Treatment: 3 Credits (3-0-0)	
Unit I	Introduction, Principles of biological treatment: Aerobic and anaerobic treatment.	5 lectures
Unit II	Bioconversion processes, kinetics of bioconversion.	5 lectures
Unit III	Aerobic treatment: Activated sludge process, trickling filter, aerated lagoons, aerobic filters, rotating biological contactors.	10 lectures
Unit IV	Anaerobic treatment: Conventional and high rate anaerobic digesters, anaerobic filters: up flow filters – fixed bed and submersed media anaerobic reactor, expanded bed, fluidized bed and moving bed reactors, down flow stationary fixed film reactors.	12 lectures
Unit V	Low-cost wastewater treatment: oxidation ponds, fishponds, maturation ponds, oxidation ditches.	10 lectures
Books:		
<ol style="list-style-type: none"> 1. Environmental Engineering Vol. II: Sewage Disposal and Air Pollution Engineering, S.K. Garg, Khanna Publications, Delhi. 2. Wastewater Treatment for Pollution Control and Reuse, S. J. Arceivala, Asolekar, Tata McGraw Hill, New Delhi. 3. Wastewater Treatment Concept and Design Approach: G. L. Karia & R. A. Christian, PHI, N. Delhi. 4. Sewage Treatment & Disposal and Waste Water Engineering (Environmental Engineering Vol. II): P. N. Modi, 		

Standard Book House, N. Delhi.

5. Wastewater Engineering: Treatment, Disposal & Reuse, Metcalf & Eddy, Tata McGraw Hill, New Delhi, 2003.

CE13042	Pavement Materials: 3 Credits (3-0-0)	
Unit I	Road making aggregates – classification, properties of aggregates, design of aggregate gradation.	10 lectures
Unit II	Bituminous road binders – penetration grade, emulsions, cut backs and modified binders; rheology of bituminous binders, modified binders.	12 lectures
Unit III	Mix design – Marshall method and Superpave procedure; design of emulsified mixes, visco-elastic and fatigue properties of bituminous mixtures, resilient modulus of pavement materials.	10 lectures
Unit IV	Requirements of paving concrete, design of mixes for recycling of bituminous and concrete pavement surfaces.	6 lectures
Unit V	Soil stabilization techniques.	4 lectures

Books:

1. A. G. Correia, Flexible Pavements, A. A. Balkema Publishers, 1996.
2. P. H. Wright, Highway Engineering, John Wiley & Sons, 1996.
3. S. K. Khanna, C. E. G. Justo and A. Veeraragavan, Highway Materials and Pavement Testing, New Chand & Bros., 2013.
4. G. N. Durhan, W. A. Marr, and W. L. DeGroat, Resilient Modulus Testing for Pavement Components, ASTM International, U.S.A., 2003.
5. S. E. Zoorob, A. C. Collop, and S. F. Brown, Performance of Bituminous and Hydraulic Materials in Pavements, CRC Press, 2002.
6. R. N. Hunter, Bituminous Mixtures in Road Construction, Thomas Telford Services Ltd., 1995.
7. ASTM, Annual Book of ASTM Standards – Section IV, Vol. 04.03, ASTM International, 2002.
8. D. Croney, and P. Croney, Design and Performance of Road Pavements, McGraw- Hill, 1998.

CE13043	River Engineering: 3 Credits (3-0-0)	
Unit I	Overview of river engineering- river classifications, thresholds in river morphology, hydraulic geometry, meander plan form, geomorphic analysis of river channel responses.	8 lectures
Unit II	Hydraulics of river flow- fundamentals of alluvial channel flows, uniform and unsteady cases, shear stress distribution, flow resistance in rivers;	8 lectures
Unit III	Scouring and its criteria- physical properties of sediments, sediment movement in rivers, shear stress, Shields diagram, scouring around bridge piers and embankments, river bed forms.	8 lectures
Unit IV	Regime rivers- analysis of river meanders, design of stable alluvial channels- regime concept, dimensional model studies for rivers, braided rivers, scaling and hierarchy in braided rivers, alternate bars, bed load transport in braided gravel-bed rivers.	8 lectures
Unit V	River training and stabilization- stream bank erosion, bank protection, flow control structures, bank protection and river training along braided rivers.	10 lectures

Books:

1. Fluvial Processes in River Engineering, H. H. Chang, John Wiley, 1988.
2. Fundamentals of Fluvial Geomorphology, R. Charlton, Taylor and Francis, 2007.
3. Braided Rivers: Process, Deposits, Ecology and Management, H. Gregory, Blackwell Publishing, 2006.
4. Sediment Transport-Theory and Practice, C. T. Yang, McGraw Hill Companies, Inc., New Delhi, 1996.
5. Fluvial Forms and Processes, D. Knighton, Edward Arnold, Baltimore, MD, 1984
6. Rivers Form and Process in Alluvial Channels, Richards, K., Methuen, NY, 1982.
7. River Mechanics, Vol. I and II, H.W. Shen, Water Resources Publication, Fort Collins, CO., 1971.
8. Applied fluvial geomorphology for river engineering management, C. R. Thorne, R. D. Hey, and M. D. Newson, John Wiley & Sons, 1997.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Year I Semester I						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	HS11101	Remedial English – I	2	0	2	03
2.	PH11101	Physics – I	3	0	2	04
3.	CY11101	Chemistry – I	3	0	2	04
4.	MA11101	Mathematics – I	3	1	0	04
5.	ES11151	Engineering Drawing	0	0	6	03
6.	ES11152	Workshop Practice	0	0	4	02
Total						20

Year I Semester II						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	HS11201	Remedial English – II	2	0	2	03
2.	PH11201	Physics – II	3	0	2	04
3.	CY11201	Chemistry – II	2	0	2	03
4.	MA11201	Mathematics – II	3	1	0	04
5.	ES11200	Basic Electrical and Electronics Engineering	3	0	2	04
6.	EC11251	Electronics Workshop – I	1	0	4	03
Total						21

Year II Semester III						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	MA12101	Mathematics – III	3	1	0	04
2.	ES12100	Basics of Computer and Programming	2	0	2	03
3.	EC12101	Principles of Electronics Circuits and Devices	2	1	2	04
4.	EC12102	Fundamentals of Telecommunication Engineering	3	0	2	04
5.	EC12151	Electronics Workshop – II	0	0	6	03
6.	EC12152	Electronic Servicing and Maintenance – I	0	0	6	03
Total						21

Year II Semester IV						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	ES12201	Technical Mechanics	3	1	0	04
2.	EC12201	Radio Engineering	3	0	2	04
3.	EC12202	Consumer Electronics	3	0	0	03
4.	EC12251	Electronic Servicing and Maintenance – II	0	0	4	02
5.	HS12201	Fundamentals of Entrepreneurship	3	0	0	03
6.	HS12202	Essence of Indian Traditional Knowledge (Audit)	2	0	0	00
7.	EC12279	Winter Internship	0	0	0	03
8.	ED12288	Extra-Curricular Activities and Discipline	0	0	0	02
Total						21

Year III Semester V						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	EC13101	Electronic Instrumentation and Measurements	3	0	2	04
2.	EC13102	Digital Electronics	2	1	2	04
3.	EC13103	Signals and Systems	2	1	0	03
4.	EC130**	Programme Elective – I	3	0	0	03
5.	EC130**	Programme Elective – II	3	0	0	03
6.	**1304*	Open Elective – 1	*	*	*	03
7.	EC13199	Project – I	0	0	2	01
Total						21

Year III Semester VI						
S.N.	Course Code	Course Title	L	T	P	Credit
1.	EC13201	Microprocessors and Applications	2	1	2	04
2.	EC13202	Analog Communication Systems	3	0	0	03
3.	EC130**	Programme Elective – III	3	0	0	03
4.	**1304*	Open Elective – II	*	*	*	03
5.	**1304*	Open Elective – III	*	*	*	03
6.	HS13277	Indian Constitution (Audit)	2	0	0	00
7.	EC13299	Project – II	0	0	6	03
8.	EC13289	Seminar	0	0	2	01
Total						20

List of Electives

Programme Elective – I						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	EC13001	Digital Signal Processing	3	0	0	03
2.	EC13002	Filters and Transmission Lines	3	0	0	03
3.	EC13003	Control System	3	0	0	03

Programme Elective – II						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	EC13011	Optical Fiber Communications	3	0	0	03
2.	EC13012	Basics of VLSI Design	3	0	0	03
3.	EC13013	Fundamentals of Electromagnetic Theory	3	0	0	03

Programme Elective – III						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	EC13021	Linear Integrated Circuits	3	0	0	03
2.	EC13022	Medical Electronics	3	0	0	03
3.	EC13023	Network Analysis and Synthesis	3	0	0	03
4.	EC13024	Digital Communications	3	0	0	03

Open Elective – I						
S. N.	Course Code	Course Title	L	T	P	Credit
2.	EC13041	Electronic Circuits and Devices	3	0	0	03

Open Elective – II						
S. N.	Course Code	Course Title	L	T	P	Credit
2.	EC13042	Instrumentation and Measurements	3	0	0	03

Open Elective – III						
S. N.	Course Code	Course Title	L	T	P	Credit
2.	EC13043	Electronic Engineering Materials	3	0	0	03

COURSE CONTENT

EC11251	Electronics Workshop – I: 3 Credits (1-0-4)	
Unit I	Introduction to all basic tools used in electronic workshop. Symbols of all basic components like relays, Switches, wire jumps and joints.	2 Lectures
Unit II	Different types of resistors, capacitors, and inductors. Drawing of symbols and constructional details of: Resistors, Capacitors, Inductors, Diodes, LED, Transistors, JFET and MOSFET.	3 Lectures
Unit III	Introduction to Logic gates. Familiarization with data sheets.	3 Lectures
Unit IV	Internal layout diagram of analog and digital ICs.	3 Lectures
Unit V	Internal diagram of the PMMC, moving iron meter.	3 Lectures
Books:		
<ol style="list-style-type: none"> 1. Basic Electronics 9th Edition by Bernald Grob & M E Schultz (TMH). 2. Electronics Source books for Engineers by George Loveday (Wheeler Publishing). 		

EC12101	Principles of Electronics Circuits and Devices: 4 Credits (2-1-2)	
Unit I	Transistors: Basic principles of operation, I/V characteristics, Modes of operation Active, Saturation and cut off, alpha, beta calculations.	5 Lectures
Unit II	Amplifier configuration: CE, CB, CC, Biasing of Transistors, Load line and Q point. Introduction to Class A, B and C amplifier circuits. Simple calculation of Voltage/ current gain (using simplified pi model), Input/ output impedance power amplifier. Introduction to multistage amplifiers.	6 Lectures
Unit III	Elementary ideas of feedback and oscillators. Operation principles of colpitt and Hartley Oscillator. Specifications of other types of oscillators.	5 Lectures
Unit IV	RC differentiator and Integrator. Introduction to Multivibrators: Astable, Monostable, Bistable. Basic ideas of JFET, MOSFET, SCR, DIAC, TRIAC, UJT and their uses.	7 Lectures
Unit V	Introduction to IC: Familiarization with popular ICs like LM 117, 317, 741, 555, 7400/7402/7406, 7805, 7809, 7812, Audio and Video amplifiers.	5 Lectures
Books:		
<ol style="list-style-type: none"> 1. Electronic Devices and Circuit theory, 8th ed. by Robert L boylestad and Louis Nashelshky (PHI). 2. Electronics Principles by A.P. Malvino (TMH). 3. Microelectronics by J. Millman and Arvin Grabel (TMH). 4. Integrated Electronics by J. Millman and C.C Halkias (TMH). 		

EC12102	Fundamentals of Telecommunication Engineering: 4 Credits (3-0-2)	
Unit I	Principles of Radiation, Introduction to EM waves and their spectrum. Types of EM wave propagation – Ground wave, Sky wave, Space wave propagation. Structure of Ionosphere, Skip distance, Radio horizon, skip zone.	10 Lectures
Unit II	Introduction to Antennas – HF, VHF, UHF and microwave antennas.	7 Lectures
Unit III	Introduction to RADAR, Satellite and Optical communication systems.	7 Lectures
Unit IV	Introduction to Transmission lines – Twisted pair wires, coaxial cables and Wave guides, Introduction to communication systems: Telephony, Telegraphy, Radio and TV transmission.	9 Lectures
Unit V	Principles of Amplitude, Frequency and phase Modulation Techniques.	9 Lectures
Books:		
<ol style="list-style-type: none"> 1. Elements of Electromagnetics 4th Edition – M.N.O. Sadiku, Oxford. 2. J.D. Kraus, Antennas, McGraw Hill, 1988. 3. Radio Engineering. by G.K. Mithal and Ravi Mittal (Khanna Pub.). 4. Electronic Communication Systems. by George Kennedy (TMH). 5. Electronics Communication Systems. by Dennis Roody and John Coolen (PHI). 6. Audio Video System Principle, Maintenance and Troubleshooting by R.G. Gupta (TMH). 7. Fundamentals of Audio and Video Systems. M.L. Anand (Khanna Pub.). 		

EC12151	Electronics Workshop – II: 3 Credits (0-0-6)	
Unit I	Soldering Practice. Designing inductors of desired value.	
Unit II	Testing of Diodes, Transistors and JFETS using ohmmeter method, Testing of Logic gates.	
Unit III	Transformer winding. Fixed and variable power supply design. PCB Design: Design rules, Manual and CAD based.	
Unit IV	Repairing of speakers, Baffle design. Study of internal block diagram of pre-amplifier and audio power amplifiers.	
Unit V	Design and assembly of a small electronic gadget.	
Books:		
1. Electronics Sourcebook for engineers by George Loveday (Wheeler publishing).		
2. Printed Circuit Board: Design and Technology by W C Bosschart.		

EC12152	Electronic Servicing and Maintenance – I: 3 Credits (0-0-6)	
Unit I	Maintenance and servicing of transformer, DC power supply.	
Unit II	Maintenance and servicing of SMPS, UPS and inverter.	
Unit III	Maintenance and servicing of PMMC and Moving Iron Ammeter and voltmeter.	
Unit IV	Maintenance and servicing of Analog Multimeter, DVM and Digital Multimeter.	
Unit V	Maintenance and servicing of Personal Computer.	
Books:		
1. Electronic Troubleshooting by Daniel R Tomal, Neal Widmer, T. Daniel (TMH).		
2. Troubleshooting Electronic Equipment by R S Khandpur (TMH).		
3. Electronic Servicing and Repairs by Trevor Linsley, Newnes.		

EC12201	Radio Engineering:4 Credits (3-0-2)	
Unit I	Aerials and Front stage: Ferrite rod MW band aerial, SW band Loop antenna, antenna coils and associated RF and mixer circuits. Transmitter antenna, quarter wave and half wave dipoles, horizontal and vertical dipoles mast and top loading.	8 Lectures
Unit II	AM Transmitter: AM Modulation, Low level and high-level modulation, Class C high level plate/collector modulators, Low level grid/base modulators, 1kW Transistor Class C collector modulator.	8 Lectures
Unit III	Super heterodyne Radio Receiver: Tuned radio frequency (TRF) and super heterodyne AM receivers, selectivity and sensitivity of receivers, RF & local oscillator and IF frequencies, image frequency and image frequency rejection, Mixer stage, Single sweep capacitor tuning ratio, AGC need and types.	9 Lectures
Unit IV	Transistorized Radio Circuit: Over all transistorized 3 band radio receiver circuit assembly, tracking and alignment techniques, testing and repair and servicing methods of detector, volume control pot cum on/off switch, dc/ac fed power supply sections and audio stages.	9 Lectures
Unit V	Radio Bands: MW and SW ₁ , SW ₂ radio wave bands, Band changer-Switches, Push button switch, construction assembly and repair. FM radio Receiver: Basics principles of FM reception, FM frequency bands, FM band intermediate frequency, FM detection methods.	8 Lectures
Books:		
1. Radio Engineering by G.K.Mithal and Ravi Mittal (Khanna Pub.).		
2. Electronic Communication Systems by George Kennedy (TMH).		
3. Electronics Communication Systems by Dennis Roody and John Coolen (PHI).		
4. Basic Radio and Television by S.P. Sharma (TMH).		
5. Audio Video System Principle, Maintenance and Troubleshooting by R.G. Gupta (TMH).		
6. Fundamentals of Audio and Video Systems by M.L. Anand (Khanna Pub.).		
7. Television and Radio Engineering by Arvind M. Dhake (TMH).		

EC12202	Consumer Electronics: 3 Credits (3-0-0)	
Unit I	Audio Fundamentals and Devices Basic characteristics of sound signal, Audio level metering, decibel level in acoustic measurement, Microphone & Types, speaker types and working principle, Sound recording principle and types.	9 Lectures
Unit II	Home theatre sound system, Digital console, FM tuner, ICs used in FM tuner TDA 7021T, PA address system.	6 Lectures
Unit III	Television Systems- Monochrome TV standards, scanning process, aspect ratio, persistence of vision and flicker, interlace scanning, picture resolution, Composite video signal, Colour TV standards, colour theory, hue, brightness, saturation, luminance and chrominance, Different types of TV camera, Transmission standards.	8 Lectures
Unit IV	Television Receivers and Video Systems PAL-D colour TV receiver, Digital TVs: LCD, LED, PLASMA, HDTV, 3-D TV, projection TV, DTH receiver, Video interface, Digital Video, SDI, HDMI Multimedia Interface, Digital Video Interface, CD and DVD player.	8 Lectures
Unit V	Home / Office Appliances Diagrams, operating principles and controller for FAX and Photocopier, Microwave Oven, Washing Machine, Air conditioner and Refrigerators, Digital camera and cam coder.	9 Lectures
Books:		
<ol style="list-style-type: none"> 1. Consumer Electronics by Bali S.P., Pearson Education India, 2010. 2. Television and Radio Engineering by Arvind M. Dhake (TMH). 3. Monochrome and Colour Television by R.R. Gulati (Wiley) 4. Monochrome and Colour Television Practice by R.R. Gulati (Wiley Eastern). 5. Basic Radio and Television by S.P. Sharma (TMH). 6. Sound System Engineering by Don Davis and Eugene Patronis (Focal Press). 		

EC12251	Electronic Servicing and Maintenance –II: 2 Credits (0-0-4)	
Unit I	Servicing and maintenance of voltage stabilizer.	
Unit II	Servicing and maintenance of AM signal generator, FM signal generator and CRO.	
Unit III	Servicing and maintenance of TV, DTH/STB, CD & DVD players.	
Unit IV	Servicing and maintenance of telephone receiver.	
Unit V	Servicing and maintenance of mobile phone and cordless phone sets.	
Books:		
<ol style="list-style-type: none"> 1. Troubleshooting and Repairing Major Appliances by Kleinert, Eric, Tab Books. 2. Major Appliances: Operation, Maintenance, Troubleshooting and Repair by Langley, Billy C, Prentice Hall. 		

EC13101	Electronic Instrumentation and Measurements: 4 Credits (3-0-2)	
Unit I	Generalized Measurement system: Accuracy, Precision, Fidelity, speed of response, static & dynamic performance characteristics, dynamic- step response, ramp response of first and second order instruments. Classifications of errors, error analysis of measurement.	8 Lectures
Unit II	Analog and Digital instruments: PMMC Galvanometer, Analog multimeter, range extension of voltmeter and ammeter, Series and shunt ohmmeter. Digital multimeter.	8 Lectures
Unit III	Signal generator and Function generator. Cathode Ray Oscilloscope, basic of CRO circuit and components. Uses of CRO for different measurement. Lissajous pattern.	8 Lectures
Unit IV	AC and DC Bridges: Introduction to DC and AC bridges for measurement of voltage / current / resistance / capacitance and inductance.	10 Lectures
Unit V	Definition of transducer, classification, resistive, capacitive, inductive, magnetic, optical, piezoelectric, pneumatic.	8 Lectures

Books:

1. Principles of Electronics instrumentation and measurements. Berlyn and Getz (McMillan Pub. Co.)
2. Course in Electrical Electronics Measurements and instrumentation. A.K. Sawhney (Dhanpat Roy & Co.).
3. Modern Electronics Instrumentation and Measurement Techniques Albert D. Heltrick, W. D. Cooper. (PHI).
4. Murthy DVS – Transducers & Instrumentation, PHI, ND, 1995.
5. Elements of Electronic Instrumentation and Measurement. Joseph J. Carr. Pearson Education.
6. PC-Based Instrumentation Concept and Practice N. Mathivanan PHI.

EC13102 Digital Electronics: 4 Credits (2-1-2)		
Unit I	Number System and Boolean Algebra: Binary Numbers. Hexadecimal number, r's complement & (r-1)'s complement, binary addition, subtraction, binary multiplication and Division. Codes and their conversions: BCD, Octal, Hexadecimal, ASCII, Gray, Excess 3. Boolean Algebra: Boolean identities, De Morgan's theorems. SOP, POS. Concepts of min term and max terms. AND-OR networks. Algebraic Simplification. Karnaugh Map, MEV technique and Quine-McClusky method.	7 Lectures
Unit II	Combinational Circuit: Basic logic gates and universal Gate. Design of Combinational logic circuit. Half Adder, Full adder, Ripple Carry adder, the carry look-ahead adders. Half- Subtractor, Full Subtractor, code converter, decoder, multiplexer, de-multiplexer parity generator and checker.	6 Lectures
Unit III	Logic Families: Different Logic families- TTL, ECL, MOS and CMOS, their operation Circuits for INVERTER, NAND, NOR. Transfer Characteristics, noise margin, propagation delay, fan in fan out, power dissipation consideration	5 Lectures
Unit IV	Data Processing Circuits MSI CHIPS: Multiplexer, Decoder, Decoder driver, 7 segment display decoder driver, Encoders Octal to Binary, Decimal to BCD encoders, Priority encoders. Implementation of combinational circuit by MSI chip.	5 Lectures
Unit V	Introduction to sequential circuits: Latch, R-S, J-K, D flip flops, Master Slave, arrangement, Edge triggered flip flops, shift registers, asynchronous and synchronous counters	5 Lectures
Books:		
<ol style="list-style-type: none"> 1. Digital Systems: Principles and Applications, Ronald J.Tocci, 10th Ed, PHI. 2. Digital Principles and Applications, A.P.Malvino, D.P.Leach, 8th Ed, TMH. 3. Fundamentals of Logic Design, C.A.Roth, Jr., Jaico, 7th Ed, Publishing House. 4. Digital Design. Morris Mano. 5th Ed. PHI, 2008. 5. Fundamentals of Digital Circuits, A. Anand Kumar, 4th Ed. PHI, 2016. 6. Digital Integrated Electronics- H.Taub& D. Shilling, 1st Ed. MGrav Hill. 7. Modern Digital Electronics R.P Jain, 4th Ed. TMH, 2010. 8. Digital Fundamentals, T. L. Floyd(9th Edition), Prentice Hall. 		

EC13103 Signals and Systems: 3 Credits (2-1-0)		
Unit I	Continuous and discrete time signals: Classification of Signals, Transformation of independent variable of signals, Basic continuous-time and discrete-time signals. Energy and power signals. Unit Impulse, Unit Step Functions and Ramp Function. Periodic and aperiodic signals, Orthogonal signal.	6 Lectures
Unit II	Basic system properties: Analysis of Continuous-time and Discrete-time LTI Systems and their properties. Linear constant co-efficient differential equations and difference equations.	5 Lectures
Unit III	Fourier-series and Fourier Transform representation of Continuous-time Signals and their properties. Discrete-Time Fourier-series and Discrete-Time Fourier Transform representation of discrete-time Signals and their properties.	5 Lectures
Unit IV	Laplace Transform and its properties. Unilateral Laplace Transform. Analysis of LTI systems using Laplace-transform. Z-transform and its properties. Unilateral Z-Transform. Analysis of LTI systems using Z – transform.	7 Lectures

Unit V	State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role. The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems.	5 Lectures
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Books:

1. Signals & Systems, Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, 2ndEd., Pearson Education. 2013.
2. Signals and Systems, S.Haykin and B. VanVeen, 2nd Ed. Wiley2007.
3. Signal Processing and Linear Systems, B.P.Lathi, PHI 2009.
4. Principles of Linear Systems and Signals, B.P. Lathi, 3rd Ed. Oxford.2009.
5. B. P. Lathi, Signal Processing and Linear Systems, Oxford University Press.

EC13201 Microprocessors and Applications: 4 Credits (2-1-2)

Unit I	Microprocessors: Evolution of microprocessor, Architecture of Intel 8085A microprocessor. Register organization, pin description. Instruction sets, operand addressing modes, instruction cycle, machine cycle, Timing diagram, Mapping of I/O to microprocessor.	6 Lectures
Unit II	Programming: Concept of Micro and Macro programming, arithmetic and logical computations, block of data moving looping, counting, time delaying operations. Stack and subroutines, Concept of stack memory.	5 Lectures
Unit III	Interrupts and Peripherals: Vectored interrupts, maskable and unmaskable interrupts. Intel 8085 software and hardware interrupts and their working mechanism. Usage of RIM, and SIM instructions.	5 Lectures
Unit IV	Peripherals: Introduction to I/O addressing. Study of peripherals like Intel 8255, 8257, 8254 and 8251. Interfacing of I/O to microprocessor.	5 Lectures
Unit V	Evolution of 16-bit microprocessors from the 8 bit 8085: Introduction to Intel 8086/8088 microprocessor architecture, Architecture, Addressing Modes, Data Movement, Arithmetic and Logic operations, Concept of segmentation and computation of physical addresses. The maximum and minimum mode of operation of 8086 processor.	7 Lectures

Books:

1. Microprocessor Architecture Programming Application with the 8085/8080A, R.S. Gaonkar, 6th Ed. Prentice Hall of India, 2013.
2. Intel Corp: The 8085/8085A. Microprocessor Book–Intel marketing communication, Wiley Interscience Publications, 1980.
3. Intel Corp. Micro Controller Handbook–Intel Publications,1994.
4. Microprocessors and Interfacing, Douglas V. Hall, McGraw Hill International Ed.
5. Assembly Language Programming the IBMPC, Alan R. Miller, SubexInc, 1987.
6. Bary B. Brey, The Intel Microprocessors:8086/8088,80186,80286,80386 & 80486, Prentice Hall, India 2018.
7. Introduction to Microprocessors, A.P. Mathur, 3rd Ed. Tata McGraw Hill,2001.
8. Fundamental of Microprocessor and Microcomputers, B. Ram, 1st Ed. Dhanpat Rai.

EC13202 Analog Communication Systems: 3 Credits (3-0-0)

Unit I	Introduction to various types of signals used in communication engineering and their Mathematical representations. Review of Fourier series, Fourier Transform.	8 Lectures
Unit II	Study and analysis of AM, FM and PM and their respective Demodulation Techniques, Advantages of FM over AM. AM Limiters. Pre-emphasis and De-emphasis. Transmitters for AM, FM, SSB, ISB systems.	10 Lectures
Unit III	Introduction to Pulse Modulation techniques – PAM, PPM, PDM and PCM systems. TDM and FDM systems and their comparison.	6 Lectures
Unit IV	Review of random signals and noise, signal to noise ratio in amplitude and angle modulated systems. Thermal and shot noise, White noise and filtered noise, AWGN Properties, Noise equivalent bandwidth concept. Discrete probability theory, Continuous random variables, Statistically independent random variables, Probability density functions of sums, Transformation of density functions, Ergodic functions, Auto correlation and Cross Correlation process, Spectral density.	10 Lectures

Unit V	TRF and super heterodyne receiver, AGC, FM receiver, sensitivity, selectivity, image frequency rejection measurements, communication receiver and its special features, PLL, Power Line Carriers & Interfacing with power line.	6 Lectures
Books: <ol style="list-style-type: none"> 1. Introduction to Analog and Digital Communication, Simon Haykin, Wiley 2009. 2. Electronic Communication Systems, G. Kenedy&Bernard, 5th Ed., TMH 1999. 3. Electronics Communication, Roody&J.Coolen, 4th Ed. Prentice Hall1977. 4. Principles of Communication System, HTaub and D. L. Schilling, (2nd Edition), McGraw Hill. 5. Communication System, Carlson, (5th Edition) Tata McGrawHill, New Delhi. 6. Modern Digital and Analog Communication Systems, B P Lathi and Zhi Ding, Oxford University Press. 7. Digital and Analog Communication System, L. W. Couch Li, (6th Edition), Pearson Education, Pvt. Ltd, 2017. 8. Signal Processing, Modulation and Noise, J A Betts, Hodder & Stoughton Ltd. 9. Communication Systems, SimanHaykin, (4th Edition), John Wiley. 10. Fundamental of Communication Systems, John G. Proakis and M Salehi, Pearson Education. 		

EC13001	Digital Signal Processing: 3 Credits (3-0-0)	
UnitI	Review of Discrete-time Fourier Transform, Frequency response of discrete time systems, All pass inverse and minimum phase systems.	5 Lectures
UnitII	DFT, Relationship of DFT to other transforms, FFT, DIT and DIF algorithms, Linear filtering using DFT and FFT.	8 Lectures
UnitIII	Frequency response of FIR filter, Design of FIR Digital filters, Window method, Park-McClellan's method, Frequency Sampling Method, Design of IIR Digital Filters, Butterworth, Chebyshev and Elliptic Approximations, Lowpass, Bandpass, Bandstop and High pass filters, Mapping formulas, Frequency transformations.	11 Lectures
UnitIV	Direct form realization of FIR and IIR systems, Lattice structure for FIR and IIR systems, Finite-word length effects. Limit cycle oscillations.	6 Lectures
UnitV	Multirate signal processing – Sampling rate conversion – applications of multirate signal processing. Parametric and non-parametric spectral estimation. Application of DSP.	10 Lectures
Books: <ol style="list-style-type: none"> 1. Digital Signal Processing, Algorithms and Applications, Proakis and Manolakis, 3rd edition, Prentice Hall of India, New Delhi. 2. Discrete-time Signal processing, Alan V Oppenheim and Ronald W Schafer, 3rd edition, Pearson. 3. The Scientist & Engineer's Guide to Digital Signal Processing, Steven W Smith. 4. Understanding Digital Signal Processing, Richard G Lyons, Pearson.2017. 5. Digital Signal Processing: A Practical approach, EmmanuelC.Ifeachoret. Al., Pearson Education, 2nd edition. 		

EC13002	Filters and Transmission Lines: 3 Credits (3-0-0)	
Unit I	Network Theorems (DC and AC) Mesh analysis, Thevenin, Norton, Superposition and Maximum power transfer theorems. Networks – One port, Two port, Balanced, unbalanced, Active, Passive, T, PI, Lattice, Ladder networks, Concepts and significance of Characteristic impedance, propagation constant, attenuation constant, phase shift constant of T and PI network, Star- Delta transformation.	10 Lectures
Unit II	Series Resonance: properties of series RLC resonance circuit, bandwidth, selectivity, frequency response, Parallel Resonance: properties of parallel RLC resonance circuit, bandwidth, selectivity, frequency response.	6 Lectures
Unit III	Study of various types of Attenuators and Equalizers (Qualitative treatment only) and their applications	7 Lectures
Unit IV	Various types of Passive Filters, LPF, HPF, BPF, BSF, m-Derived and their applications, basic concept of active filters and their comparison with passive filters.	8 Lectures
Unit V	Transmission-line Equation and solutions, Reflection and Transmission coefficients, Standing wave and Standing wave ratio. Line Impedance and Admittance. Smith chart and Single stub matching	9 Lectures

Books:	
1.	Networks, Lines and Fields, John D. Ryder. (PHI) 1 st Ed.1978.
2.	Circuit Theory (Analysis and Synthesis), A. Chakraborty (Dhanpat Rai & Co.), 3 rd Ed.2010.
3.	Network Analysis, M.E. VanValkenburg (PHI), 3rd Ed. 2006.
4.	Network and Systems, D. Roy Choudhury (New Age International), 1 st Ed. 1998.
5.	Networks, Filters and Transmission lines, P.K. Jain, Gurbir Kaur(TMh), 1 st Ed. 1994.

EC13003	Control System: 3 Credits (3-0-0)	
Unit I	Elementary control concepts: Open loop and close loop control system. Transfer function, impulse response, modeling of electrical and mechanical (translational and rotational)systems, DC motor block diagram simplification, and signal flow graphs.	8 Lectures
Unit II	Transient response analysis of I and II order system: Type of systems and its effect on error function, stability, steady state error.	6 Lectures
Unit III	Stability concept: Routh Hurwitz criterion of stability, Root locus techniques: Root-Loci and complementary root loci rules for root locus plots.	6 Lectures
Unit IV	Frequency Response Analysis: Nyquist plot and Bode plot. Gain and phase margins, compensation typical examples. Compensators and controllers: lead, lag and lag-lead compensators, proportional, PI and PID controllers.	10 Lectures
Unit V	State Space Analysis: State Variables and State Model, State Transition Matrix and its properties, Concept of Controllability and Observability. Digital Control System: Sampled Data Control System, Step Response (First & Second Order Systems), Introduction to Digital PID Controller, block schematic of PLC and addressing.	10 Lectures

Books:	
1.	Control Systems Engineering, Nagaratha and Gopal.
2.	Discrete-Time Control Systems, K. Ogata, Pearson Education/PHI, 2 Edition.
3.	Modern Control Engg, K. Ogata, 2nd ed., PHI, 1995.
4.	Automatic Control Systems, B. C. Kuo, 9th ed., PHI, 1995.

EC13011	Optical Fiber Communications: 3 Credits (3-0-0)	
Unit I	Introduction: Advantage over other communication system. Optical wave guides-Ray theory of transmission, Total internal reflection, acceptance angle, Numerical aperture, skews rays.	6 Lectures
Unit II	EM theory of optical propagation. Setup and graded index fibers, Modes and their coupling, single mode fiber, mode field diameter, spot size. Transmission characteristics of optical fiber- Intrinsic and Extrinsic absorption, Linear scattering, Fiber band loss, Material and waveguide dispersion, Intermodal dispersion, Modified single mode fiber.	8 Lectures
Unit III	Optical sources-LASERS: Absorption and emission of radiation, Einstein relation, Population inversion, Optical feedback and threshold condition for laser oscillation, Optical emission from semiconductors- PN Junction, Spontaneous and stimulated emission and lasing. Heterojunctions, semiconductor injection laser, efficiency, Laser modes, Single mode operations, Injection Laser characteristics. LED structure-surface and edge emitters. LED characteristics-Optical output power, output spectrum, Modulation BW.	10 Lectures
Unit IV	Optical detectors-Principles, Direct and Indirect absorption, Group 3 to 5 alloy. Quantum efficiency, p-n-p-n, Avalanche and p-i-n photodiode. Receiver structure-Low and high impedance front end	8 Lectures
Unit V	Optical amplification-Semiconductor Laser and fiber amplifier. Optical TDM, WDM. Transmission link analysis, Point to point links, System considerations, Link power budget, Rise time budget. Fiber attenuation measurements-Optical time domain reflecto-meter. Fiber fault location, Dispersion measurements.	8 Lectures

Books:	
1.	Optical Fiber Communication: Principles and Practice, 3rd Ed. John Senior, Prentice Hall of India, New Delhi., 1992.
2.	Optical Fiber Communication, 3rd Ed., G. Keiser, McGraw Hill International, New York, 2000.

EC13012 Basics of VLSI Design: 3 Credits (3-0-0)		
Unit I	VLSI design flow Design; MOS Transistor; DC Transfer Characteristics: Static CMOS Inverter DC Characteristics.	8 Lectures
Unit II	CMOS Processing Technology: Layout design rules, CMOS Process enhancements; Stick Diagrams; Technology-Related CAD Issues, Manufacturing Issues.	8 Lectures
Unit III	Delay: Delay Models; Logical Efforts of Paths, Timing Analysis of Delay Models Power: Dynamic Power and Static Power.	6 Lectures
Unit IV	Combinational Circuit Design: CMOS Logic Gates, The Compound Gates, Pass Transistors and Transmission Gates, Tristate buffer, Multiplexers. Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass-Transistor Circuits. Subthreshold Circuit Design.	10 Lectures
Unit V	Sequential MOS logic circuitry: Behavioral of Bistable element, Flip-Flop. Sequencing Static Circuits; Circuit Design of Latches and Flip-Flops; Memory: SRAM; DRAM; Semiconductor memories: Introduction, Read-Only Memory circuits, SRAM circuits, DRAM circuits.	8 Lectures
Books: <ol style="list-style-type: none"> 1. "CMOS VLSI Design", Pearson Education, Neil H.E. Weste, David Harris, Ayan Banerjee, 3rd Edition. 2. "CMOS digital Integrated Circuits, Analysis and Design", Sung-Mo Kang and Yusuf Leblebici, Tata McGraw-Hill Publishing Company Limited, New Delhi. 3. "Basic VLSI Design", Douglas. A. Pucknell, KamaranEshraghian, PHI,3rd Edition. 4. "Introduction to VLSI Circuits & Systems", John P. Uyemura Wiley India Edition. 		

EC13013 Fundamentals of Electromagnetic Theory: 3 Credits (3-0-0)		
Unit I	Review of vector Algebra, Rectangular, Cylindrical, spherical Coordinate systems and transformation, Vector Calculus – Gradient, Divergence and curl, Green's and Stroke theorems.	6 Lectures
Unit II	Electrostatics, Coulomb's law. Gauss's law and applications. Electric potential. Poisson's and Laplace equations. Method of images. Electrostatic fields in matter. Dielectrics and dielectric polarization. Capacitors with dielectric substrates	10 Lectures
Unit III	Magnetostatics, Biot-Savart's Law, Ampere Circuits Law, Applications of Potentials, Magnetic Force- charge particle, current elements, Magnetic field in Potentials, Magnetic Force- charge particle, current elements, Magnetic field in Material space, Magnetization, Magnetic BoundaryConditions, Inductor, Inductances, Magnetic Energy.	10 Lectures
Unit IV	Time-varying Fields, Faraday's Law, Transformer and Motional Electromotive Forces, Displacement current, Maxwell Equations, Time Varying Harmonic Fields.	7 Lectures
Unit V	Electromagnetic waves, General wave Equations, waves in lossy dielectrics, Plane wave in lossless dielectrics, free space, good conductors, Wave polarization, Poynting vector and reflection of waves	7 Lectures
Books: <ol style="list-style-type: none"> 1. Elements of Electromagnetics 4th Edition – M.N.O. Sadiku, Oxford. 2. Electromagnetic waves and radiating systems, 2nd edition, E. Jordan and K. Balmin, Prentice Hall of India, New Delhi, 2001. 3. Advanced Engineering Electromagnetics, C.A. Balanis, John Willy and Sons, New York, 2001. 4. Electromagnetics, 4th edition, J.D.Kraus, Tata McGrawhill, New Delhi, 1991. 		

EC13021 Linear Integrated Circuits: 3 Credits (3-0-0)		
Unit I	Differential Amplifiers (DA): Single ended and fully differential output topology, voltage gain, CMRR, PSRR and ICMR and output swing of BJT-based DA., active loads, IC biasing, current source and sink, current mirrors, level translators' circuits.	10 Lectures
Unit II	OPAMP: Block-level and internal circuit level working of op-amp, ideal characteristics, open loop gain, negative feedback configurations with closed loop gain, various linear applications adder, subtractor, averager, precision rectifiers.	7 Lectures

Unit III	Integrator, differentiator, log and antilog amplifiers, absolute value detectors, voltage limiters, instrumentation amplifier etc., non-linear applications such as comparators, zero crossing detector, analog multipliers, etc.	7 Lectures
Unit IV	OSCILLATORS: Classification, Barkhausen Criterion, frequency stability, inverting and non-inverting Schmitt triggers, integrator, square wave and triangular wave oscillators, Phase Shift Oscillator, Wein Bridge Oscillator, voltage-controlled oscillator (VCO) circuit design using OP-AMP, PLL.	8 Lectures
Unit V	ACTIVE FILTERS and CONVERTERS: classification and characterization of filters, Various types of active RC-filters of first order and second order and their design. State variable Biquadratic filters. Converters: Various types of Analog to Digital and Digital to Analog Converter, working principle, characteristics.	10 Lectures
Books: <ol style="list-style-type: none"> 1. Op-Amps and Linear Integrated Circuits 4 Edition Author(s): Ramakant A. Gayakwad Publisher: PHI Learning. 2. Linear Integrator Circuits by D.R. Chaudhury and S.B. Jain, New age International Publishers, Fourth Edition. 3. Operational Amplifiers with Linear Integrated Circuits 4th Edition, Author(s): William D. Stanley, Publisher: Pearson (2004). 4. Electronics Principles by A. P. Malvino, Tata McGraw Hill. 5. Integrated Electronic circuits by J. Millman and C.C.Halkias, TMH. 6. Electronic Devices and Circuits, Fourth Edition by David A. Bell. (PHI). 7. Electronics Circuits By: D. Shilling, Tata McGrawHill. 		

EC13022 Medical Electronics: 3 Credits (3-0-0)		
Unit I	Introduction: General measurements and diagnostic system, classification, biomedical signal acquisition, difficulties in signal acquisition. ECG: signal origin, parameters-QRS detection different techniques, ST segment analysis, Arrhythmia, Arrhythmia analysis, Arrhythmia monitoring system.	8 Lectures
Unit II	ECG Data Reduction, compression: Turning Point, AZTEC, Cortes, FAN, Transformation, Karhunen - Loeve Transform, DPCM, Huffman coding, Data compression. Signal averaging: Basics, Signal averaging as a digital filter, A typical averager, Software and limitations.	8 Lectures
Unit III	Frequency Domain Analysis, Spectral analysis, linear filtering, cepstral analysis and homomorphic filtering. Removal of high frequency noise, motion artefacts and power line interference in ECG, Time Series Analysis: AR models, Estimation of AR parameters, ARMA models. Spectral modelling and analysis of PCG signals.	8 Lectures
Unit IV	Spectral Estimation, Evaluation of prosthetic heart valves using PSD techniques. Comparison of the PSD estimation methods. Event Detection and waveform analysis: Identification of heart sounds, Morphological analysis of ECG waves and Activity.	8 Lectures
Unit V	Adaptive Filtering: Introduction, General structure, LMS, adaptive noise cancellation in ECG, cancellation of ECG from EMG signal, Cancellation of maternal ECG in fetal ECG. EEG: EEG signal characteristics, Sleep EEG classification and epilepsy.	8 Lectures
Books: <ol style="list-style-type: none"> 1. Biomedical Signal Analysis: A case study approach, Rangaraj M Rangayyan, John Wiley publications. 2. Biomedical Signal Processing Time and Frequency Domains Analysis (Volume I), Arnon Cohen, CRC Press. 3. Biomedical Signal Processing Principles and Techniques, D.C.Reddy, Tata Mc Graw-Hill. 4. Biomedical Digital Signal Processing, Willis J. Tompkins, PHI. 		

EC13023 Network Analysis and Synthesis: 3 Credits (3-0-0)		
Unit I	Review of Network Theorems, Formulations of network equations: First-order systems, Natural response, Initial conditions, complete response of First- order systems, zero state and zero input responses. Second order system, Natural response, Overdamped, Underdamped and critically damped case. Geometry of plane, Unit step and unit impulse response, linear system with sinusoidal inputs, impedance and admittance, power, concept of Complex frequency.	10 Lectures
Unit II	Transform Impedances Network functions of one port and two port networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot, frequency response.	6 Lectures

Unit III	Characterization of LTI two port networks ZY, ABCD and h-parameters, reciprocity and symmetry. Inter relationships between the parameters, interconnections of two port networks. Transient analysis of different electrical circuits with and without initial conditions.	6 Lectures
Unit IV	Positive real function; definition and properties; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions using Foster and Cauer first and second forms.	11 Lectures
Unit V	Graph of a Network, definitions, tree, co tree, link, basic loop and basic cut set, Incidence matrix, cut set matrix, Tie set matrix Duality, Loop and Node methods of analysis.	9 Lectures
Books:		
<ol style="list-style-type: none"> 1. Network Analysis, M.E. Van Valkenburg, Prentice Hall of India. 2. An Introduction to Circuit analysis: A System Approach, Donald E. Scott, McGraw Hill Book Company. 3. Circuit Theory, A.Chakrabarti, Dhanpat Rai and Co. 4. Networks and Systems, D.RoyChoudhary, Wiley Eastern Ltd. 		

EC13024	Digital Communication: 3 Credits (3-0-0)	
Unit I	Review of Sampling theorem, Pulse-Amplitude Modulation, Channel bandwidth. Natural and Flat top sampling. Quantization of signals, Quantization error, Pulse-code modulation (PCM), Electrical representation of binary digits, PCM system, Companding, Multiplexing. Differential PCM, Delta modulation, Adaptive delta modulation, Vocoders, Channel Vocoder, Linear Predictive coder.	10 Lectures
Unit II	Digital Modulation Techniques: Binary Phase-Shift Keying (BPSK), Differential Phase-Shift Keying, Differentially Encoded PSK (DEPSK), Quadrature Phase- Shift Keying (QPSK), Quadrature Amplitude Shift Keying (QASK), Binary Frequency-Shift Keying (BFSK), Similarity of BPSK and BFSK, M-ary FSK, Minimum Shift Keying (MSK).	10 Lectures
Unit III	Data Transmission: Baseband signal receiver, Probability of error. Matched Filter, Probability of error in Matched filter, Coherent reception of PSK and FSK, Non-Coherent reception of FSK, PSK and QPSK.	6 Lectures
Unit IV	Error probability of BPSK, BFSK and QPSK. Bit-by-bit encoding versus Symbol-by-Symbol encoding, Relationship between Bit error rate and Symbol Error rate, comparison of modulation systems.	6 Lectures
Unit V	Information Theory and Coding: Discrete messages, information, Entropy, Information rate, coding to increase average information per bit. Shannon's theorem, Capacity of Gaussian channel, Bandwidth-S/N trade off, use of orthogonal signals to attain Shannon's limit, Efficiency of orthogonal signal transmission, Coding: Parity check bit coding, error detection and error correction coding, Block codes, Convolution codes, Comparison of error rates in coded and uncoded transmission.	10 Lectures
Books:		
<ol style="list-style-type: none"> 1. Electronic Communications Systems, Wayne Tomasi, Pearson Education. 2. Principles of Communication Systems, Taub and Schilling TMH. 3. Digital Communication, S. Haykin, Wiley. 4. Analog and Digital Communication, S. Haykin, Wiley. 		

EC13041	Electronic Circuits and Devices: 3 Credits (3-0-0)	
Unit I	Operational Amplifier: Introduction to op-amp, offset voltage/currents, CMRR, Feedback amplifier, Linear and Nonlinear application, active filters, performance comparison of typical op-amp (741C, LM411, LM118, LM108, QD611.)	10 Lectures
Unit II	Regulated Power Supply: Regulated power supply design, capacitive(CRC) filter-based power supply, Linear series regulators, single op-amp regulator, three terminal regulators, adjustable power supply.	7 Lectures
Unit III	Linear ICs such as LM78XX, LM79XX, LM317, LM 337, Switched capacitor conversion (LM-7660). Switching power supply, Basic principles, Buck regulator, Boost regulator.	7 Lectures

Unit IV	Tuned Amplifiers: Single tuned circuit, FET & BJT amplifier, FET tuned amplifier, tuned transistor amplifier with tuned load, narrow band approximation and tuning (Synchronous & Stagger), cascade tuned IF amplifier, Design of tuned amplifier, oscillator possibility and sensitivity. Oscillators: Wein bridge, phase shift, twin T and crystal oscillators.	10 Lectures
Unit V	Power Switches and ICs: Introductory idea and use of SCR, Diac, Triac and UJT circuits. Integrated Circuits: Introduction to IC, familiarization with popular IC NE/SE-555, 7400 7402, 7406, Audio and Video amplifiers.	8 Lectures

Books:

1. Basic Electronics and Linear Circuits, 6th Ed., N.N. Bhargav, D.C. Kulshreshta, S.C.Gupta, Tata McGraw Hill, New Delhi, 2001.
2. Electronics Principles, 6th Ed., A.P. Malvino, Tata McGraw Hill, New Delhi, 1999.
3. Micro Electronics, 2nd Ed., J. Millman, Arvin Grabel, Tata McGraw Hill, New Delhi, 1999.
4. Integrated Electronics, J. Millman, & C.C. Halkias, Tata McGraw Hill, New Delhi, 1999.

EC13042	Instrumentation and Measurements: 3 Credits (3-0-0)	
Unit I	Generalized Measurement system: Accuracy, Precision, Fidelity, speed of response, static & dynamic performance characteristics, dynamic- step response, ramp response of first order instrument. Classifications of errors, error analysis of measurement.	10 Lectures
Unit II	Introduction to DC and AC bridges for measurement of voltage / current / resistance / capacitance and inductance.	8 Lectures
Unit III	Principle and working of voltmeter, ammeter and ohmmeter, Introduction to DVM, Electronic multimeter.	7 Lectures
Unit IV	Cathode Ray Oscilloscope- Introduction, cathode ray tube, electron gun, and deflection plates, basic CRO circuit, Lissajous pattern. Digital multimeter, Signal generator and Function generator using multi op-amp and crystal.	7 Lectures
Unit V	Definition of transducer, classification, resistive, capacitive, inductive, magnetic, optical, piezoelectric, pneumatic.	10 Lectures

Books:

1. Principles of Electronics instrumentation and measurements. Berlyn and Getz (McMillan Pub. Co.).
2. A Course in Electrical Electronics Measurements and instrumentation. A.K.Sawhney (Dhanpat Roy & Co.).
3. Modern Electronics Instrumentation and Measurement Techniques Albert D. Heltrick, W. D. Cooper. (PHI).
4. Murthy DVS – Transducers & Instrumentation, PHI, ND, 1995.
5. Elements of Electronic Instrumentation and Measurement. Joseph J. Carr. Pearson Education.
6. PC-Based Instrumentation Concept and Practice N. Mathivanan PHI.

EC13043	Electronic Engineering Materials: 3 Credits (3-0-0)	
Unit I	Conducting materials - Effect of temperature on resistivity of different conducting materials, Metal and alloys for fuses, Properties and specifications of wire, cable and antenna material. Semiconducting materials - Element and compound semiconductors and their properties, Carrier concentration in semiconductors, Variation of fermi level and carrier concentration with temperature, Hall effect.	10 Lectures
Unit II	Magnetic materials – Different types of magnetic materials and their properties, Diamagnetism, Paramagnetism, ferromagnetism, anti ferromagnetism and ferrimagnetism.	6 Lectures
Unit III	Hard and Soft magnetic materials, Magnetic materials used at high frequencies. Frequency dependence of dielectric constant; Ferroelectricity and Piezoelectricity in materials.	6 Lectures
Unit IV	Optical properties of materials: metals, insulators and semiconductors, Phosphorescence and fluorescence, Different phosphors used in CRO screens, Liquid crystal as display, materials for LEDs, Photoconductivity and photo conducting materials. Light interaction with solids; Absorption, Transmission and Reflection; Luminescence; Photoconductivity; Lasers.	10 Lectures

Unit V	Insulating materials- Atomic interpretation of dielectric material of mono atomic gases and poly atomic molecules, general feature of static dielectric constant of solids, piezo electricity and piezoelectric materials, Dielectric properties in alternating fields: Frequency dependence of electronic and ionic polarizability, complex dielectric constant, dielectric relaxation and losses, temperature dependence, superconductors.	10 Lectures
Books: <ol style="list-style-type: none"> 1. Electronics Engineering Materials and Devices, John Allyson, 1st Ed.,Tata McGraw Hills 1973. 2. Introduction to Materials Science for Engineers, James Shakelfolk, 6th Ed. Macmillan Publishing Co. 2007. 3. Materials Science and Engineering, V. Raghavan, 2nd Ed. Prentice Hall of India. 2015. 4. Electrical Engineering Materials, A.J.Dekker, 3rd Ed. Prentice Hall of India, New Delhi 2007. 		

DEPARTMENT OF ELECTRICAL ENGINEERING

Year I Semester I						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	HS11101	Remedial English – I	2	0	2	03
2.	PH11101	Physics – I	3	0	2	04
3.	CY11101	Chemistry – I	3	0	2	04
4.	MA11101	Mathematics – I	3	1	0	04
5.	ES11151	Engineering Drawing	0	0	6	03
6.	ES11152	Workshop Practice	0	0	4	02
Total						20

Year I Semester II						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	HS11201	Remedial English – II	2	0	2	03
2.	PH11201	Physics – II	3	0	2	04
3.	CY11201	Chemistry – II	2	0	2	03
4.	MA11201	Mathematics – II	3	1	0	04
5.	ES11200	Basic Electrical and Electronics Engineering	3	0	2	04
6.	EE11251	Electrical Drawing	0	0	4	02
Total						20

Year II Semester III						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	MA12101	Mathematics – III	3	1	0	04
2.	ES12100	Basics of Computer and Programming	2	0	2	03
3.	EE12101	Electrical Trade Theory	3	0	0	03
4.	EE12102	Renewable Energy Power Plants	3	0	2	04
5.	EE12151	Electrical Maintenance Lab	1	0	4	03
6.	EE12152	Electrical Workshop	0	0	4	02
7.	EE12153	Domestic Wiring and Service Connection	0	0	6	03
Total						22

Year II Semester IV						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	ES12201	Technical Mechanics	3	1	0	04
2.	EE12201	Electrical Installation and Practice	2	0	2	03
3.	EE12202	Electrical Appliances	3	0	2	04
4.	EE12203	Electrical Measurements and Instruments	3	0	2	04
5.	EE12204	Operation and Maintenance of Electrical Machines	2	0	2	03
6.	HS12201	Fundamentals of Entrepreneurship	3	0	0	03
7.	HS12277	Essence of Indian Traditional Knowledge (Audit)	2	0	0	00
8.	EE12279	Winter Internship	0	0	6	03
9.	ED12288	Extra-Curricular Activities and Discipline	0	0	0	02
Total						26

Year III Semester V						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	EE13101	Electrical Circuit Analysis	3	1	0	04
2.	EE13102	Electrical Machines – I	3	0	2	04
3.	EE13103	Power Systems	3	0	2	04
4.	EE13104	Electrical Estimating and Costing	3	0	2	04
5.	EE130**	Programme Elective – I	3	0	0	03

6.	EE130**	Programme Elective – II	3	0	0	03
7.	**1304*	Open Elective – I	*	*	*	03
8.	EE13199	Project – I	0	0	2	01
Total						26

Year III Semester VI						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	EE13201	Electrical Machines – II	3	0	2	04
2.	EE13202	Power System Switchgear and Protection	3	0	2	04
3.	EE13203	Electrical Power Utilization	3	0	2	04
4.	EE130**	Programme Elective – III	3	0	0	03
5.	**1304*	Open Elective – II	*	*	*	03
6.	**1304*	Open Elective – III	*	*	*	03
7.	HS13277	Indian Constitution (Audit)	2	0	0	00
8.	EE13299	Project – II	0	0	6	03
9.	EE13289	Seminar	0	0	2	01
Total						25

LIST OF ELECTIVES

Programme Elective – I						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	EE13001	Power Electronics	3	0	0	03
2.	EE13002	Digital Electronics	3	0	0	03
3.	EE13003	Switched Mode Power Supply Systems	3	0	0	03

Programme Elective – II						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	EE13011	Instrumentation	3	0	0	03
2.	EE13012	Industrial Drives	3	0	0	03
3.	EE13013	Fundamentals of Microprocessors	3	0	0	03

Programme Elective – III						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	EE13021	Illumination Engineering	3	0	0	03
2.	EE13022	Switchgear and Protection	3	0	0	03

Open Elective – I						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	EE13041	Energy Conservation and Audit	3	0	0	03
2.	EE13042	Soft Computing Techniques	3	0	0	03

Open Elective – II						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	EE13043	Energy Efficiency and Audit	3	0	0	03
2.	EE13044	Artificial Intelligence	3	0	0	03

Open Elective – III						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	EE13045	Solar Power Technologies	3	0	0	03
2.	EE13046	Wind Power Technologies	3	0	0	03

COURSE CONTENT

ES11200	Basic Electrical and Electronics Engineering: 4 Credits (3-0-2)	
Unit I	Introduction to Circuit Elements & Batteries: Effect of electric current, electromagnetism, AC circuits using R, L & C, Single phase and three phase circuits, Batteries: Types of cells and basic operation of Lead acid, Ni-Cd, Nickel-alkaline cells. Charging and maintenance of batteries.	10 lectures
Unit II	Elementary Idea of Rotating Electrical Machines and Transformer: Working principle, types, rating and constructions etc.	7 lectures
Unit III	Definitions of Different Circuit Elements: Like Resistors, Capacitors and Inductors, Definitions, types (fixed and variable) color code, ratings; Special components: Thermistor, VDR, LDR and their use.	7 lectures
Unit IV	Semiconductors: Intrinsic & Extrinsic, PN junction diode, diode ratings. Application of diodes: half & full wave rectifier, rectifier filter, clipping and clamping, voltage multiplier etc. Special diodes: Zener diode, LED, Varactor diode, photo diode, solar cell, principles and uses.	9 lectures
Unit V	Transistor: Definition, PNP and NPN types, CE, CC, CB Amplifier circuits, Introduction to SCR, characteristics and applications. Oscillators: Definition with example, circuits. Digital Electronics: Elementary ideas on binary numbers and logic gates (AND, OR, NOT), ICs Pin configuration of some specific ICs.	9 lectures
Books: <ol style="list-style-type: none"> 1. Basic Electronics and linear circuits by Bhargava, Kulshreshth and Gupta, TTTI Chandigarh. 2. A Text Book of Electrical Technology (Vol I) by B.L. Thereja, S. Chand Publication. 3. Fundamentals of Electronics by E. Norman Lurch (John Wiley & Sons). 4. Basic Electronics by Mavino A.P. (Mc. Graw Hill) 5. Basic Electrical Engg. (Vol-I) By P.S. Dhogal TMH. 6. Electrical Engg. by H.Cotton. 7. Electrical Trade Theory, by M.L. Ghosh – TMH 		
EE11251	Electrical Drawing: 2 Credits (0-0-4)	
Unit I	Electrical Symbols and Tools: Symbolic representation, Fuse assembly, knife, Cable lugs, brush holder, wire joints, etc.	
Unit II	Electrical Machines: Transformers, DC machines, Field poles, Armature, Commutator, lap and wave windings, AC machines: rotor and stator of induction machine, synchronous machine, and single-phase machines.	
Unit III	Electrical Measuring Instruments: Drawing of common electrical measuring instruments such as Moving coil, Moving iron, Electro-dynamometer type, induction type ammeter, voltmeter, wattmeter, energy meter; megger, frequency meter, power factor meter, etc.	
Unit IV	Electrical Power Generating and Substations: Layout diagram of hydro power plant, thermal power plant, nuclear power plant, distribution substation. 11KV and 33KV substations, layout diagram of switch gear and transformer, layout diagram of power plants and substation.	
Unit V	Power System Equipment and Control: Panels for DC generator and alternators, Control panel of substations, pole and towers, HT and LT Insulators, Earthing systems, Circuit breakers, lightning arrestors, air brake switches, House wiring.	
Books: <ol style="list-style-type: none"> 1. Electrical Engineering Drawing by S.K. Bhattacharya, Willey Easter Ltd. 2. Electrical Engineering Drawing by R.B. Sharma, Satya Publications. 3. Electrical Design; Estimation & Costing by K.B. Raina & S.K. Bhattacharya, New Age Int. 4. Electrical Substation and Practice by S. Rao, Khanna Publication. 5. Electrical Engineering Drawing by Nagar, Satya Publications. 		
EE12101	Electrical Trade Theory: 3 Credits (3-0-0)	
Unit I	Basic Concepts: Fundamentals of AC, electric circuit, circuit elements, Ohm's law Kirchoff's laws and its applications.	7 lectures

Unit II	Effects of Electric current: Heating effect, chemical effect, electromagnetic effect, electrostatic effect, primary and secondary cells, lead acid battery, battery charging, testing, application, maintenance.	7 lectures
Unit III	Magnetism and Electromagnetism: Magnetic materials, terminology properties of magnetic lines of forces. Faraday's laws of electromagnetic induction, Lenz's law, Fleming's Left Hand and Right-Hand rules.	8 lectures
Unit IV	Transformers: Introduction to transformer and its basics, different types of transformers and their constructions, emf equation, ideal and practical transformers, their ratings and applications.	10 lectures
Unit V	Introduction to Electromechanical Energy Conversion (EMEC) Devices: Generator and motor action, constructional features of elementary machines, generation of emf and torque, production of rotating magnetic fields, basic principles of dc machines, characteristics and its applications, basic principles of ac machines, characteristics, and its applications.	10 lectures
Books: <ol style="list-style-type: none"> 1. Electrical Trade Theory by M.L. Ghosh. TMH. 2. A Text Book of Electrical Technology (Vol-1) by B.L. Thareja, Nirja Publication. 3. Basic Circuit Analysis by K.V.V. Murthy & M.S. Kamath. 4. Electrical Circuits – Schaum Series. 5. Basic Electrical Engg. by P.S. Dhogal – TMH. 		

EE12102	Renewable Energy Power Plants: 4 Credits (3-0-2)	
Unit I	Solar PV and Concentrated Solar Power Plants: Solar Map of India: Global solar power radiation, Solar PV Concentrated Solar Power (CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors Solar Photovoltaic (PV) power plant: components layout, construction, working. Rooftop solar PV power system.	8 lectures
Unit II	Large Wind Power Plants: Wind Map of India: Wind power density in watts per square meter Lift and drag principle; long path theory. Geared Type Wind Power Plants: components, layout and working. Direct drive type wind power plants: components, layout and working. Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG), Wound Rotor Induction Generator (WRIG); Variable Speed Electric Generators: Doubly fed induction generator (DFIG), wound rotor synchronous generator (WRSG), permanent magnet synchronous generator (PMSG). Electrical Engineering Curriculum Structure 150.	10 lectures
Unit III	Small Wind Turbines: Horizontal Axis Small Wind Turbine: direct drive type, components and working Horizontal axis small wind turbine: geared type, components and working Vertical axis small wind turbine: direct drive and geared, components and working. Types of towers and installation of small wind turbines on roof tops and open fields. Electric generators used in small wind power plants.	8 lectures
Unit IV	Micro-hydro Power Plants: Energy conversion process of hydro power plant. Classification of hydro power plant: High, medium, and low head. Layouts of micro-hydro power plants Construction and working of hydro turbines used in different types of hydro power plant: <ul style="list-style-type: none"> ➤ High head – Pelton turbine ➤ Medium head – Francis turbine ➤ Low head – Kaplan turbine. Safety Practices for micro hydro power plants.	8 lectures
Unit V	Biomass-based Power Plants: Properties of solid fuel for biomass power plants: bagasse, wood chips, rice husk, municipal waste Properties of liquid and gaseous fuel for biomass power plants: Jatropha, biodiesel gobar gas Layout of a Bio-chemical based (e.g. biogas) power plant: Layout of a Thermo-chemical based (e.g. Municipal waste) power plant, Layout of a Agro-chemical based (e.g. bio-diesel) power plant.	8 lectures

Books:	
1.	Deambi, Suneel: From Sunlight to Electricity: a practical handbook on solar photovoltaic application; TERI, New Delhi ISBN:9788179935736.
2.	David M. Buchla, Thomas E. Kissell, Thomas L. Floyd - Renewable Energy Systems, Pearson Education New Delhi , ISBN: 9789332586826.
3.	Rachel, Sthuthi; Earnest, Joshua – Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9.
4.	Khoiyangbam, R S Navindu; Gupta and Sushil Kumar; Biogas Technology: Towards Sustainable Development; TERI, New Delhi; ISBN: 9788179934043.
5.	Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304.
6.	Wizelius, Tore & Earnest, Joshua -PHI Learning, New Delhi, ISBN: 978-8120351660.
7.	Kothari, D.P. et al: Renewable Energy Sources and Emerging Technologies, PHI Learning, New Delhi, ISBN: -978-81-203-4470-9.
8.	Bhadra, S.N., Kastha, D., Banerjee, S, Wind Electrical Systems installation; Oxford University Press, New Delhi, ISBN: 9780195670936.
9.	O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi (ISBN: 978-9386173-683).

EE12151	Electrical Maintenance Lab: 3 Credits (1-0-4)
Unit I	Study of Electrical shock and treatment.; Demonstration of safety accessories and tools.
Unit II	Measurement of power and power factor in AC circuits (single phase, three phase star and delta).; Soldering and welding practice.; Study of Batteries (Dry cells and secondary cells), charging and testing methods.; Study and repair of DC motor starters
Unit III	Study of drives for: Lathe machines.; Compressors.; Motorized domestic appliances.
Unit IV	Study of earthing provision for electrical installation.; Studies of different categories of electrical insulations and megger testing.
Unit V	Use of winding machine and winding practice for (i) transformers (ii) small motors
Books:	
1. Electrician: 1 st year Trade Theory: CIMI Madras, New Age International Publication.	
2. Electrical Trade Theory: by M.L. Ghosh, Tata MaGraw Hill.	
3. Handbook of Electrical Engineering: by S.L. Bhatia, Khanna Publishers.	

EE12152	Electrical Workshop: 2 Credits (0-0-4)
Unit I	Electrical Workshop: Electrical symbols; voltage, current; resistance; power relations; wire joints;
Unit II	Different Types of Connections: Switchboard connection; simple wiring in TRS and PVC conduit system; Staircase wiring.
Unit III	Wiring Practice for Different Devices: Wiring practice of various types of lamps and fans; Energy meter and mains board connection, electrical measurement, wiring for backup power supply including inverter, battery and load, etc.
Unit IV	Study of Different Types Cables/Wires/Fuses/Circuit Breakers etc: Identification and study of different types of cables/wires and switches and their uses, study of different types of fuses & fuse carriers, MCB (miniature circuit breaker), ELCB (Earth Leakage Circuit Breaker), MCCB (Molded Case Circuit Breaker) and RCCB (Residual Current Circuit Breaker) with ratings and usages. Wiring of Power circuit for controlling power device (16A socket), wiring of power distribution arrangement using single phase MCB distribution board with ELCB.
Unit V	Identification/Dismantling/Assembling of AC & DC Machines/Fans etc: Identification of different windings and components of D.C. and AC machines, Dismantling and assembling of a ceiling-fan or table fan, single phase transformer. Testing of battery for its charged and discharged condition and to make connections for charging.
Books:	
1. Electrician: 1 st year Trade Theory: CIMI Madras, New Age International Publication.	
2. Electrical Trade Theory: by M.L. Ghosh, Tata MaGraw Hill.	
3. Fundamentals of Electrical Engineering and electronics by B.L. Thereja, Nirja Publication.	
4. Introduction to Computers (5 th edition) by Peter Norton TMG	

EE12153 Domestic Wiring and Service Connection: 3 Credits (0-0-6)	
Unit I	Different Types of Wiring: Wiring – types of wiring: cleat wiring, casing, and capping wiring; various types of wood joints, applications, link clips, wooden screw, wooden plugs etc., their applications. Conduit wiring, conduit accessories, PVC conduit & metal conduit. Specifications of electrical wiring accessories; wires and cables, switches, GI wires, GI strips. Holders, various types, ceiling rose etc.
Unit II	Domestic, Industrial and Godown Wiring etc.: Domestic, industrial, and decorative light fittings, staircase wiring, godown wiring, series parallel wiring, multiple point wiring, cable termination, IS 732-1982 code of Practice for internal wiring; guideline for internal wiring, wiring technique; looping in junction box, tree ring etc., advantages and disadvantages, applications. Use of intermediate switch for wiring and various applications.
Unit III	Single and Multi-Line Wiring: Preparation of wiring diagram; schematic single line and multi-line wiring diagrams using NEC symbols, testing of low and medium voltage wiring installation. Service connection; types, suitability, service cable selection, erection, and application. Fuses; types, ratings, materials, testing, different types of switches, fuse units, applications.
Unit IV	Earting: Earthing, system and equipment earthing, purpose, types of earthing, electrodes, earth leakage circuit breaker. Measurement of earth resistance IS 3043 codes of practice for earthing, measures to improve earthing.
Unit V	Estimating: Estimates; abstract, detailed (main & sub) supplementary and revised estimate. Work contract (Lump sum, schedule & piece work contract). Tender: single, limited, open, global, security deposit, general condition and technical specification, measurement books. Preparation of estimate for small low and medium voltage installation. Inventory control.
Books:	
<ol style="list-style-type: none"> 1. Electrical Estimating & Costing, K.B. Raina, Tata McGraw Hill, New Delhi, 1996. 2. Electrical Design: Estimating and Costing, K.B. Raina & S.K. Bhattacharya, New Age. 3. Electrical Specification for Building Construction, J.E. Traise, Prentice Hall Inc, NJ, 1978. 	

EE12201 Electrical Installation and Practice: 3 Credits (2-0-2)		
Unit I	Generations: Introduction, classification, advantages and disadvantages, site selection, working principle, layout and main components of diesel, thermal, hydro and nuclear power plants and non-conventional source of energy.	6 lectures
Unit II	Substation Practices: Introduction, types of substations, power transformer and their parts, HT and LT metering, safety requirements, electrical diagrams, electrical symbols relevant to substations, various arrangements of bus bars, isolating switches, CT, PT, circuit breakers, lighting Arrestors. Substation earthing, protective measures as per relevant IE rules.	6 lectures
Unit III	Transmission and Distribution Through Overhead Lines Systems: Introduction, types of poles and their construction, mechanical design of overhead lines, overhead line conductors, insulators, stays, guarding wires, anti-climbing devices, etc.	6 lectures
Unit IV	Distribution Through Under Ground Cables: Introduction, types of underground cables used, factors determining selection of LT power cables, advantages and disadvantages in comparison to overhead lines, constructional details of cables, laying of underground cables and its terminations, consumer service connections, cable fault location, maintenance.	5 lectures
Unit V	Campus Lighting: Terminology of illumination, laws of illuminations, street lighting, various types of light sources and design considerations of good lighting scheme and service feeder pillar.	5 lectures
Books:		
<ol style="list-style-type: none"> 1. Electrical substation engineering and practices, S. Rao, Khanna Publication, Delhi 1992. 2. Electrical Power S.L Uppal, Khanna Publishing, Delhi 1996. 3. Electrical Design estimating and Costing, K.B Raina, S.K Bhattacharya, WEL, New Delhi, 2003. 4. Non-Conventional Energy Resources, D.S Chauhan & S.K Srivastava, New Age, New Delhi. 		

EE12202 Electrical Appliances: 4 Credits (3-0-2)		
Unit I	Principles of electric heating appliances, power consumption, use and importance of name plate details, current rating, principle of temperature controls in heaters, thermostat, testing IE rules.	10 lectures

Unit II	Construction, circuit, intermittent and incipient fault diagnosis and repair of heating appliances; manual and automatic electric iron. Manual and automatic electric kettle, oven, hot plate, immersion water heater, geyser, soldering iron, electric toaster and electric blanket	10 lectures
Unit III	Principles of illumination-luminous flux, intensity, lumen and luminance, use of lux meter, Classification of electric lamps-incandescent lamp, fluorescent lamp, mercury vapour lamp, sodium vapour lamp, neon lamp, arc lamp, halogen lamp, CFL, Comparison and applications of lamps, twin tube connection and its use, stroboscopic effect, decorative lamps, principles of operation, power consumption, fault diagnosis.	10 lectures
Unit IV	Repair of motorized appliances- ceiling fan, table fan, mixer, blower, hair drier, electric sewing machine, refrigerator, electric washing machine, air conditioner etc.	8 lectures
Unit V	Safety and preventive maintenance fundamentals, IE rules, appliances for hazardous area.	4 lectures
Books: 1. Study of Electrical Appliances and Drives, K.B. Bhatia, Khanna Publishers, New Delhi, 2001. 2. How to repair Electrical Appliances, Wheelers, D.B. Taraporewala and sons Co. P. Ltd, Mumbai. 3. Electrician 1 st Year Trade Theory, CIMI, New Age International, New Delhi, 1993.		

EE12203	Electrical Measurements and Instruments: 4 Credits (3-0-2)	
Unit I	Units and Dimensions, Absolute, Fundamental and Derived units, Dimensional analysis. MKS system, SI system, Practical units.	6 lectures
Unit II	Absolute and Secondary Instruments, Essentials of Indicating Instruments, deflecting torque, controlling torque, Damping torque, Advantages of spring control over gravity control.	7 lectures
Unit III	PMDC instrument: Constructional details, principle of operation, uses, advantages and disadvantages. Loading effect of voltmeter and voltage drop effect of ammeter in circuits. Extension of ranges of ammeter and voltmeter and related problems. Moving Iron Instruments: Constructional details, types, principle of operation, advantages, and disadvantages. Dynamometer type instruments: Constructional details, types, principle of operation, advantages, and disadvantages. Dynamometer type instruments as an ammeter and voltmeter. Ohmmeter: Series and shunt type, working, uses, Megger, its construction and working principle.	12 lectures
Unit IV	Induction type instrument: Induction type ammeters and voltmeters, uses, advantages and disadvantages. Induction type wattmeter, constructional details, principle, advantages, and disadvantages. Energy meters:Constructional details, working principle, types, errors, testing and adjustment of Energy meter. Electromagnetic Relay.	10 lectures
Unit V	Frequency meters: Classification, constructional and working principle, Electrodynamic and moving iron p.f meter:Working principle, types and uses.	7 lectures
Books: 1. A course in Electrical and Electronics Meas. and Instrumentation, by A.K. Sawhney, Dhanpat Rai and Sons. 2. Advanced Electrical Technology by H. Cotton, Wheeler Publication. 3. Electrical Measurement by E.W. Golding.		

EE12204	Operation and Maintenance of Electrical Machines: 3 Credits (2-0-2)	
Unit I	Electromagnetic Induction: Relation between magnetism and electricity, production of induced emf and current, Faraday's Laws of electromagnetic induction, direction of induced emf and current, Lenz's Law, dynamically and statically induced emf.	4 lectures
Unit II	DC Generator: Constructional details, emf equation, circuit model, armature reaction and commutation process, self and separately excited generator, Testing of dc generator, applications, care and maintenance of dc generator	5 lectures
Unit III	DC Motors: Principle and types, relation between applied voltage, back emf, armature voltage drop, starting and use of starters, types of starter, characteristics, speed control, testing and maintenance of dc motors.	5 lectures

Unit IV	Induction Motors: Constructional details, principle of operation, concept of slip, rotor emf and current, torque equation, torque-slip characteristics, method of starting and testing.	6 lectures
Unit V	Alternators: Constructional details, types of alternators, principle of operation, synchronous speed and frequency, emf equation, characteristics and voltage regulation. Testing of alternators. Single phase motors: classification, principle of operation, starting and their applications.	8 lectures
Books:		
<ol style="list-style-type: none"> 1. Testing, Commissioning, Opn. and Maintenance of Electrical Engineering by S. Rao, Khanna Pub. 1. Electrician 1st Year Trade Theory, CIMI, New Age International, New Delhi, 1998. 2. Electrical Machinery, P. S. Bimbhra, Khanna Publication, New Delhi. 3. Electrical Machine, S. K. Bhattacharya, Tata McGraw Hill. 		

EE13101	Electrical Circuit Analysis: 4 Credits (3-1-0)	
Unit I	Kirchhoff's Laws & its direct applications, circuit elements & its behavior with AC & DC supply, nodal analysis & mesh analysis, Star/Delta transformations.	6 lectures
Unit II	Network theorems: Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum power transfer theorem etc.	8 lectures
Unit III	Series & Parallel AC Circuits: RL, RC, & RLC circuits, phasor algebra/diagrams, resonance in series & parallel circuits.	8 lectures
Unit IV	Transients in DC & AC Circuits.	10 lectures
Unit V	Polyphase Circuits, Two-port Networks	10 lectures
Books:		
<ol style="list-style-type: none"> 1. Theory and Problems of Electric Networks by B.R. Gupta, S. Chand Publications. 2. Networks and Systems by D. Roy Choudhury, New Age International. 3. Problems in Electrical Engineering by Parker Smith, CBS Publication. 4. Electric Circuits, Shaum Series. 		

EE13102	Electrical Machines – I: 4 Credits (3-0-2)	
Unit I	Magnetic Circuit Concepts: Different types of magnetic materials, permeability, flux density, magnetic field intensity, magneto-motive force, reluctance etc.	4 lectures
Unit II	Electromechanical Energy Conversions: Elementary concepts of electrical machines, classifications, its common features, basic principles of generator & motor, torque due to non-alignment of two magnetic fields, EMF induced in a coil rotating in a magnetic field.	10 lectures
Unit III	DC Machines: Constructional features and working principle of DC machine as a generator and a motor; Types DC machines; EMF equation of generator, building up of emf, relation between EMF induced and terminal voltage enumerating the brush drop. The concept of armature reaction, inter poles; Back EMF and its significance, analogy of back EMF with armature reaction, torque equation, Types of DC motors, characteristics and applications.	12 lectures
Unit IV	Speed Control of DC Motor: DC Motor Starters. Conventional methods for speed control of DC motor.	6 lectures
Unit V	Transformers: Introduction, constructional details and working principle, emf equations, phasor diagrams, equivalent circuits, losses, efficiency and condition for maximum efficiency, rating of the transformers, autotransformers & its applications, parallel operation of transformers, 3-phase transformers, instrument transformers.	10 lectures
Books:		
<ol style="list-style-type: none"> 1. Electric Machinery, by Fitzgerald, Kingsley and Umans, TMH, 2003. 2. Introduction to Electrical Machines and Transformers, by Guru & Hiziroglu, OXFORD, 2008. 3. Electrical Machines, by C. I. Hubert, Pearson Education, 2007. 		

EE13103 Power Systems: 4 Credits (3-0-2)		
Unit I	Different Types of Power Stations: Hydro Electric Station, Thermal power station, Nuclear power station, Diesel power station, Solar and wind power generation systems, Hybrid generation systems, Cogeneration systems, Basics of different types of electric generators.	10 lectures
Unit II	Performance of the transmission lines: Performance of the short, medium and long transmission lines, voltage regulation, corona effect, Ferranti effect.	10 lectures
Unit III	Mechanical Design: Mechanical Design of overhead lines. Underground cables. Common types of cable faults. Line insulators.	10 lectures
Unit IV	Distribution systems: AC distribution system, DC distribution system. Introduction to rural electrification, power theft and its solution.	10 lectures
Unit V	Indian Electricity Rules 1956: The Indian Electricity Rules 1956 for generation, transmission and distribution systems.	2 lectures
Books:		
1. Generation, Distribution and Utilization of Electrical Energy, by C.L. Wadhwa, New Age Inter.		
2. Electrical Power System by Stevenson.		
3. Electrical Power Generation, Distribution and Utilization by Soni, Gupta and Bhatnagar, Dhanpat Rai & Sons.		

EE13104 Electrical Estimating and Costing: 4 Credits (3-0-2)		
Unit I	Estimating and its purpose, procedure of estimating plan and specification, electrical schedule, types of load, wiring plan, size of cable, sub-circuits, material estimation labour calculation, estimating form, overhead charges, profit, method of estimating. Purchase system, catalogue, market survey, tenders, comparative statement, order for supply, payment of bills.	9 lectures
Unit II	Estimating and costing of domestic installation: relevant IE Rules and symbols for domestic installation. CTS wiring of a room, cleat/casing capping wiring in a house, conduit wiring of building; dining hall, institute hall, hospital etc. with appropriate drawing; estimating of industrial installation: IE Rules and symbols and chart notes on house wiring, determination of rating of cable, fuse, switches, starter.	9 lectures
Unit III	Estimating with appropriate drawing of installation of plan, single-line representation, wiring diagram of workshop, mills, pumping stations; Earthing: relevant IE and IS Rules, determination of size of earth wire and earth plate for domestic and motor installation.	6 lectures
Unit IV	Drawing and estimation of different types of earthing, Transmission and distribution (OH and UG), IS and IE Rules, planning and designing of lines with different kinds of fixtures, earthing etc. Estimating and drawing of LT lines on unit basis; estimating and drawing of HTOH lines, estimating and drawing of HTUG cable.	9 lectures
Unit V	Design and estimation of street lighting (both OH and UG system); electrification, design, drawing and estimating of a locality (outdoor); service connections (OH and UG): methods of installation of service lines IE Rules, drawing and estimating of materials required for giving connection to domestic and industrial consumers, substations: types of substation schemes and components, IS and IE Rules, design, drawing and estimating of single, double pole, pole mounted transformer substation for a given load, indoor Substation – layout and drawing with panels and estimating.	9 lectures
Books:		
1. Electrical Estimating & Costing by K.B. Raina, TMH Publication.		
2. Electrical Design, Estimating and Costing by K. B. Raina & S.K. Bhattacharjee, New Age International Publication.		
3. Electrical Specification for Building Construction by J.E. Traise, Prentice Hall.		
4. Business correspondence and Report Writing by R.C. Sharma and Krishna Mohan, TMH.		

EE13201 Electrical Machines – II: 4 Credits (3-0-2)		
Unit I	Three Phase Induction Machines: Construction, principles of operation, production of rotating field, flux, mmf & phasors, rotor frequency, rotor emf, current and power; losses and efficiency; phasor diagram; equivalent circuit; torque-slip characteristics; power-slip characteristics; operating characteristics of induction motors, induction	10 lectures

	motor stability; starting and speed control of three phase induction motors.	
Unit II	Induction Generator: Working principle, equivalent circuits, types of excitations, single phase and three phase operation.	6 lectures
Unit III	Three Phase Synchronous Machine: construction and excitation system; types of synchronous generators; three phase winding; synchronous speed and frequency; emf equation; phasor diagram and equivalent circuit; armature reaction; voltage regulation; power transfer equation; parallel operation of alternator; infinite busbar; load sharing; salient pole synchronous generators; synchronous motors; starting, constant speed operation; phasor diagram, equivalent circuit of synchronous motors; V-curves; speed control of synchronous motor.	10 lectures
Unit IV	Single Phase Induction Motors: Cross field and double revolving field theory; starting and operating characteristics; performance equations; applications.	8 lectures
Unit V	Applications of Induction Motors/Generators: Applications of three phase induction motors, synchronous motors in industries; applications induction generators in wind and micro-hydel power generating stations; synchronous condensers and synchronous phase modifiers for industrial applications.	8 lectures
Books:		
<ol style="list-style-type: none"> 1. Electrical Machinery, by Fitzgerald, Tata McGraw Hill. 2. Generalized Theory of Electrical Machines, by P.S. Bimbhra, Khanna Publications, Delhi, 1992. 3. Electrical Machinery, by P. S. Bimbhra, Khanna Publications, Delhi, 1996. 4. Electrical Machine, by S. K. Bhattacharya, Tata McGraw Hill, New Delhi 1998. 		

EE13202	Power System Switchgear and Protection: 4 Credits (3-0-2)	
Unit I	Causes and consequences of high currents, basics of per unit systems, single line diagram, introduction to symmetrical components and symmetrical and unsymmetrical faults.	8 lectures
Unit II	Characteristics of relay, primary and back-up protection, Methods of discrimination: time and current grading, Relays: classification, basic working principle of electromagnetic and induction relay.	6 lectures
Unit III	Basic principles of over current relays, directional relays, distance relays, differential relay, their types, characteristics, torque equation. Introduction to static relays. Application and phase comparator	8 lectures
Unit IV	Neutral Grounding – definition and difference from equipment grounding, disadvantages of neutral ungrounded system, types of neutral grounding, criterion for neutral grounding practice, Earthing of Transformer.	8 lectures
Unit V	Apparatus protection: transformer protection, motor protection, alternator protection, Circuit breakers: construction, working principle, arc interruption theory, transient recovery voltage, RRRV, current chopping, auto reclosing, types of CB and its relative advantages and disadvantages.	12 lectures
Books:		
<ol style="list-style-type: none"> 1. Switchgear and Protection in power system, by Sunil S. Rao, Khanna publishers, Delhi. 2. Power System Protection and Switchgear, by B. Ravindranath and M. Chander, NAI, New Delhi. 3. Power System Protection and Switchgear', by Badri Ram and Vishwakarma, D.N., TMH, 1995. 4. The Art and Science of Protective Relaying, by C. Russel Mason, Wiley Eastern Ltd., New Delhi. 		

EE13203	Electrical Power Utilization: 4 Credits (3-0-2)	
Unit I	Electric Heating: Advantages, classification, resistance heating, design of heating element, types of electrodes, induction heating, dielectric heating, and dielectric loss calculation; electric welding: types of resistance welding, arc welding.	8 lectures
Unit II	Electric Traction: AC and DC systems, low frequency and high frequency systems, composite system and Kando system.	8 lectures
Unit III	Illumination: Nature of light, eye sensitivity, definition, laws of illumination, evaluation of different light sources, polar curve, Rousseau diagram, luminous efficacy, types of lamps, lighting schemes & its design. Life of the lamps and their mechanism of breakdown. Energy efficient illumination systems, case studies on efficient illumination systems; fundamentals of light efficient buildings.	9 lectures

Unit IV	Electrochemical Process: Laws of electrolyte, electric deposition, application of electrolysis, factors affecting electro-chemical process.	8 lectures
Unit V	Refrigeration and Heating: Refrigeration cycle, refrigeration systems, domestic Refrigerator, water cooler, desert cooler, air conditioning, industrial air conditioning, heating of buildings, calculation of rating of electrical equipments, related numerical problems.	9 lectures
Books:		
<ol style="list-style-type: none"> 1. Art and Science of Utilisation of Electrical Energy, by H. Pratap, Dhanpat Rai and Sons, Delhi, 1987. 2. Generation, Distribution and Utilisation of Electrical Energy, by C.L. Wadhwa, New Age Inter. 3. Electric Power Utilisation, by Taylor, Print Longman, Bombay, 1996. 		

EE13001	Power Electronics: 3 Credits (3-0-0)	
Unit I	Power Diodes: Basic structures and V-I characteristics, breakdown voltage, ON state losses, switching state characteristics, principle of operation, diode snubbers, Schottkey diodes.	6 lectures
Unit II	Thyristor: Thyristor family, operating principle of thyristor, dynamic characteristics, ratings and protection, temperature rise and cooling of thyristor; thyristor firing circuits: R and RC triggering circuit, UJT triggering; thyristor commutation-line, load and forced; series and parallel operation of thyristor.	9 lectures
Unit III	Power MOSFETS: Structure, V-I characteristics, switching characteristics, operating limitations and safe operating area, gate and snubber circuit, GTO: basic structures and characteristics; IGBT: structure and characteristics, drive and snubber circuit, FCT, MCT, RCT, Power BJT and its applications.	9 lectures
Unit IV	Rectifiers: Uncontrolled rectifiers, basic concepts, single phase bridge rectifier, three phase full bridge rectifiers, single phase controlled rectifiers: half-wave, full-wave and semi-converters.	9 lectures
Unit V	Application of Power Electronics: AC voltage regulator, different types of choppers; speed control of dc motor; zero crossing detectors; timing circuits: mono-stable and a-stable type, 555 IC timer; introduction to PLCs.	9 lectures
Books:		
<ol style="list-style-type: none"> 1. Power Electronics, by P.S. Bimbhra, Khanna Publisher. 2. Power Electronics, by H.C. Rai, Galgotia Publications. 3. Power Electronics, by P.C. Sen, TMH. 		

EE13002	Digital Electronics: 3 Credits (3-0-0)	
Unit I	Logic Gates: Fundamental concepts on analogue and digital signals; Introduction to Logic gates, Symbols, operations and truth tables of AND, OR, NAND, NOR, EX-OR & EX-NOR gates; Merits & demerits of universal logic gates, realization of basic gates using universal logic gates.	4 lectures
Unit II	Boolean Algebra and K-map: Introduction to Boolean algebra and K-map; Introduction to sum of product and product of sum logic equations- their simplifications and logic circuit implementations using basic and universal logic gates separately; Number systems and their conversions.	10 lectures
Unit III	Digital Logic and Logic Families: Representation and reduction technique of logic functions using Boolean algebra and K-map; Introduction to combinational and sequential logic circuits.	10 lectures
Unit IV	Design of Combinational Logic Circuits: Multiplexer, De-multiplexer, Decoder, Encoder, Comparator etc. using basic logic gates and universal logic gates separately, implementation of the same circuits using relevant IC chips.	8 lectures
Unit V	Design of Sequential Logic Circuits: Introduction to Flip flops, classifications and working principles of flip flops, design of different types of flip flops using universal logic gates; clocked circuits, design of counters (Asynchronous & Synchronous); timing circuits- application of logic gates and op-amp in timing circuits; Design of ADC and DAC circuits, Registers.	10 lectures
Books:		
1. Digital Principles and Applications, by A. P. Malvino and D. P. Leach, TMH, New Delhi, 1997.		

2. Digital Logic and Computer Design, by M. Morris Mano, PHI, New Delhi, 1998.
3. Modern Digital Electronics, by R. P Jain, Tata McGraw Hill Publishing Co. Ltd., 2003.
4. Electronic Circuit Design Ideas, by B. Laxminarayanan, Asian Book (P) Ltd. International, Singapore.

EE13003 Switched Mode Power Supply Systems: 3 Credits (3-0-0)		
Unit I	Introduction to Power Supply Topologies: Overview of switch mode power supply, basic operations of linear power supply regulators- basic operations, merits and demerits, fundamentals of switching regulators, applications.	8 lectures
Unit II	Buck Switching Converters: Basic operation, optimum switching frequency, design considerations for selection of output filter inductor and capacitors, switching losses and efficiency, applications; boost switching converters: basic operations- discontinuous and continuous modes, design considerations for discontinuous mode boost regulators, applications.	10 lectures
Unit III	Push-Pull and Forward Converters: Basic operation-master/slave outputs, design considerations for power transformer, output filters, switching losses, limitations of output power and input voltage in push-pull topology; basic operation of forward converter topology, design considerations for input & output voltage, power transformer, filter circuit etc., applications.	8 lectures
Unit IV	Half and Full Bridge Converters: Basic operation, output filter design considerations, and limitations of output power in half bridge converter topology; basic operation of full bridge converter, design considerations for magnetic and filter circuit etc., applications.	8 lectures
Unit V	Flyback Converters: Introduction, applications, basic operations in discontinuous and continuous mode, output filter design considerations for magnetic and filter circuit etc. under discontinuous and continuous modes, applications.	8 lectures
Books:		
<ol style="list-style-type: none"> 1. Switching Power Supply Design, A. I Pressman, McGraw Hill Inc., New Delhi, 1991. 2. High Frequency Switching Power Supplies: Theory & Design, George Chryssis, McGraw Hill Book Company, New Delhi, 1995. 3. Power Switching Converters, Simon Ang, A. Oliva, Taylor& Francis, London, 2004. 4. Power Electronics: Converters, Applications & Design, Mohan, Undeland& Robbins, John Wiley & Sons, 2001. 5. Power Electronics: Circuits, Devices & Applications, M. H. Rashid, Prentice Hall of India, New Delhi, 2001. 		

EE13011 Instrumentation: 3 Credits (3-0-0)		
Unit I	Accuracy, precision, types, classification and probability of errors, Gaussian errors; sensitivity, resolution and stability.	8 lectures
Unit II	Mathematical model for instrumentation, calibration, transducers.	9 lectures
Unit III	Measurement of temperature, flow, pressure, vibration and strain etc.	9 lectures
Unit IV	Fundamentals of RF telemetry, basic Telemetry system components, methods of coding	8 lectures
Unit V	Bio Electronics, Equipment and principles.	8 lectures
Books:		
<ol style="list-style-type: none"> 1. A course in Electrical and Electronics Meas. and Instr., by A.K. Sawhney, Dhanpat Rai and Sons. 2. Advanced Electrical Technology by H. Cotton, Wheeler Publication. 3. Electrical Measurement by E.W. Golding. 		

EE13012 Industrial Drives: 3 Credits (3-0-0)		
Unit I	Introduction, Concept classification of electric drives, Dynamics of Electrical Drives, Types of loads. Electric drives diagram, speed torque characteristic, dynamics of motor, load combination and stability of electric drives, characteristics of electric motors.	10 lectures
Unit II	DC motors, basic relations, characteristics, 3-phase induction motor: basic relation & characteristics, 3-phase synchronous motor: basic relation and characteristics,	8 lectures
Unit III	Starting effect of starting on power supply, motor & load, methods of starting, Acceleration time, Energy relation during starting, Methods to reduce energy loss during starting.	6 lectures

Unit IV	Electric braking, Types of braking with active & passive torque loads, Energy relation during braking, Dynamics of braking. Rating and heating of motors. Heating effect, Loading conditions & classes of duty.	8 lectures
Unit V	Determination of power rating of electric motors for different application, Effect of load inertia, Load equalization, Control of electric drives, conventional control, Power semiconductor control, Industrial of electric drives.	10 lectures
Books:		
<ol style="list-style-type: none"> 1. Electrical Machines Drives and Power Systems by Wildi, Asian Books (P) Ltd. 2. Thyristorised Power Controllers by Dubes, Doralda, Joshi and Sinha. 3. Electrical Machinery by P.S. Bimbhara, Khana Publications. 		

EE13013	Fundamentals of Microprocessors: 3 Credits (3-0-0)	
Unit I	Evolution of Microprocessor, type pin out diagram and Architecture and Micro Computer Systems and their applications.	10 lectures
Unit II	Instructions and Timing of Intel 8085 Microprocessor.	8 lectures
Unit III	Assembly language programming of the Intel 8085.	6 lectures
Unit IV	Interfacing the peripherals and applications.	8 lectures
Unit V	Trends in Microprocessor Technology and Bus Standards, etc.	10 lectures
Books:		
<ol style="list-style-type: none"> 1. Software Made Simple by R.K. Taxali, Tata Mc Graw Hill. 2. Microprocessor Architecture Programming and Application, by R.S. Gaonkar, New Age International. 3. Digital Computer Electronics: An Introduction to Micro Computers by A.P. Malvino, TMH. 		

EE13021	Illumination Engineering: 3 Credits (3-0-0)	
Unit I	Fundamentals of Illumination: Basic illumination, Terminology, Laws of illumination Polar curves, polar curve: its meaning and applications for designing the lamp. Concept of Photometry, Measurement of illumination Lighting calculation methods, Watt /m ² method, Lumens or light flux method, Point to point Method Standards for illumination	8 lectures
Unit II	Types of lamps: Incandescent lamp, ARC lamps – AC and DC arc lamps, Fluorescent lamp, Types of other lamps: Mercury vapour lamp, HPMV lamp, Mercury iodide lamp, Sodium vapour lamp, Halogen Lamps, Ultraviolet Lamps, Neon Lamps. Neon Sign Tubes. Metal halides, HID and Arc lamps LED lamps, CFL, Lasers Selection Criteria for lamps	10 lectures
Unit III	Illumination Control and Control Circuits: Purpose of lighting control, and Dimmer, Resistance type, Salt water Dimmer, Working principle and operation of Dimmer, Transformer and their types, Dimmer Transformer, Auto transformer dimmer, Two winding transformer dimmer Electronic Dimmer: working principle and operation (a) Thyristor operated dimmer (b) Triac operated dimmer. Control of Enhance Lighting, Methods used for light control, Control circuits for lamps (refer): ON/OFF control Control circuits for lamps: single lamp controlled by single switch, two switches. Single Lamp control by two point method, three point method and four point method, 195 Electrical Engineering Curriculum Structure	8 lectures
Unit IV	Standard for Various Locations of Interior Illumination: Design considerations for Interior location of residences (1/2/3/4 BHK), Commercial, Industrial premises Illumination scheme for different Interior locations of Residential, Commercial, industrial unit	8 lectures
Unit V	Illumination for Interior Applications : Factory Lighting Street Lighting (Latest Technology), Flood Lighting Railway Lighting Lighting for advertisement /Hoardings/sports lighting, Agriculture and Horticulture lighting, Health Care Centres / Hospitals, Decorating Purposes, Stage Lighting, Aquariums and Shipyards Special purpose lamps used in photography video films.	8 lectures

Books:

1. Lindsey, Jack L., Applied Illumination Engineering, The Fairmont Press Inc.
2. Simons, R. H., Bean, Robert; Lighting Engineering: Applied Calculations, Architectural Press. ISBN: 0750650516.
3. Casimer M Decusatis, Handbook of Applied Photometry, Springer, ISBN 1563964163.
4. Butterworths, Lyons Stanley, Handbook of Industrial Lighting, Butterworths.
5. Simpson Robert S, Lighting Control Technology and Applications, Focal Press.
6. Kao Chen, Energy Management in Illuminating Systems, CRC Press.

EE13022 Switchgear and Protection:3 Credits (3-0-0)		
Unit I	Basics of Protection: Necessity, functions of protective system. Normal and abnormal conditions. Types of faults and their causes. Protection zones and backup protection. Short circuit fault calculations in lines fed by generators through transformers. Need of current limiting reactors and their arrangements.	8 lectures
Unit II	Circuit Interruption Devices: Isolators- Vertical break, Horizontal break and Pantograph type. HRC fuses – Construction, working, characteristics and applications. Arc formation process, methods of arc extinction (High resistance and Low resistance), Arc voltage, Recovery voltage, Re-striking voltage, RRRV. HT circuit breakers (Sulphur-hexa Fluoride (SF ₆), Vacuum circuit breaker) - Working, construction, specifications and applications. L.T. circuit breaker (Air circuit breakers (ACB), Miniature circuit breakers (MCB), Moulded case circuit breakers (MCCB) and Earth leakage circuit breaker (ELCB)) - Working and applications. Selection of LT and HT circuit breakers (ratings), Selection of MCCB for motors. Gas insulated switchgear.	10 lectures
Unit III	Protective Relays: Fundamental quality requirements: Selectivity, Speed, Sensitivity, Reliability, Simplicity, Economy. Basic relay terminology- Protective relay, Relay time, Pick up, Reset current, current setting, Plug setting multiplier, Time setting multiplier. Protective relays: Classification, principle of working, construction and operation of – Electromagnetic (Attracted armature type, Solenoid type, Watt-hour meter type) relay, Thermal relay. Block diagram and working of Static relay. Overcurrent relay-Time current characteristics. Electrical Engineering Curriculum Structure 198 Microprocessor based over current relays: Block diagram, working. Distance relaying- Principle, operation of Definite distance relays. Directional relay: Need and operation. Operation of current and voltage differential relay.	8 lectures
Unit IV	Protection of Alternator and Transformer: Alternator Protection: Faults, Differential protection Over current, earth fault, overheating and field failure, protection. Reverse power protection. Transformer Protection: Faults, Differential, over current, earth fault, over heating protection, Limitations of differential protection. Buchholz relay: Construction, operation, merits and demerits.	8 lectures
Unit V	Protection of Motors, Bus-bar and Transmission Line Motor: Faults. Short circuit protection, Overload protection, Single phase preventer. Bus Bar and Transmission Line: Faults on Bus bar and Transmission Lines. Bus bar protection: Differential and Fault bus protection. Transmission line: Over current, Distance and Pilot wire protection.	8 lectures

Books:

1. Mehta V. K., Rohit Mehta, Principles of Power System, S. Chand and Co., New Delhi., ISBN: 978-81-2192-496-2.
1. Rao.Sunil S., Switchgear and Protection, Khanna Publishers, New Delhi, ISBN: 978-81-7409-232-3.
2. Singh, R. P., Switchgear and Power System Protection, PHI Learning, New Delhi, ISBN: 978-81-203-3660-5.
3. Gupta. J. B., Switchgear and Protection, S. K. Kataria and Sons, New Delhi, ISBN: 978-93-5014-372-8.
4. Veerapan, N., Krishnamurty, S. R., Switchgear and Protection, S. Chand and Co., New Delhi. ISBN: 978-81-2193-2127.
5. Ram, Badri; Vishwakarma D. N., Power System Protection and Switchgear, McGraw-Hill, New Delhi. ISBN: 978-07-107774-X.

EE13041 Energy Conservation and Audit:3 Credits (3-0-0)		
Unit I	Introduction: General energy problem, Sector wise Energy consumption, demand supply gap, Scope for energy conservation and its benefits; Energy Efficiency Principle–Maximum energy efficiency, Maximum cost effectiveness; Mandatory	8 lectures

	provisions of EC act; Features of EC act-Standards and labelling, designated consumers, Energy Conservation Building Codes (ECBC);	
Unit II	Energy Conservation Approaches in Industries: Methods and techniques of energy conservation in ventilation and air conditioners- compressors pumps, fans and blowers - Area Sealing, Insulating the Heating / cooling fluid pipes, automatic door closing- Air curtain, Thermostat / Control; Energy conservation in electric furnaces, ovens and boilers.	10 lectures
Unit III	Energy Conservation Option: New equipment, technology, staffing, training; Calculation and costing of energy conservation project; Depreciation cost, sinking fund method. Cost evaluation by Return on Investment(ROI) and pay back method etc.	10 lectures
Unit IV	Performance Improvement of Existing Power Plant: Cogeneration, small hydro, DG Set; Demand side management; Load response programmes; Types of tariffs and restructuring of electric tariff; Technical measures to optimize T and D losses.	8 lectures
Unit V	Energy Audit: Energy audit and its benefits; Energy flow diagram; Preliminary, Detailed energy audit; Methodology of -preliminary energy audit and Detailed energy audit – Phase I, Pre audit, Phase II- Audit and Phase III- Post audit; Energy audit report; Electrical Measuring Instruments - Power Analyzer.	6 lectures
Books: <ol style="list-style-type: none"> 1. Electric Energy Generation, Utilisation and Conservation Sivaganaraju, S Pearson, New Delhi, 2012. 2. Project Management, Prasanna Chandra, Tata Mcgraw Hill, New Delhi. 3. O.P. Jakhar, Energy Conservations in Buildings, Khanna Publishing House, New Delhi. 4. Financial Management, Prasanna Chandra Tata Mcgraw Hill, New Delhi. 5. Energy management Handbook, Prasanna Chandra, Tata Mcgraw Hill, New Delhi. 6. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi (ed. 2018). 		

EE13042	Soft Computing Techniques: 3 Credits (3-0-0)	
Unit I	Problem Solving Methods and Tools: Problem Space, Problem solving, State space, Algorithm's performance and complexity, Search Algorithms, Depth first search method, Breadth first search methods their comparison, A*, AO*, Branch and Bound search techniques, p type, Np complete and Np Hard problems.	8 lectures
Unit II	Evolutionary Computing Methods: Principles of Evolutionary Processes and genetics, A history of Evolutionary computation and introduction to evolutionary algorithms, Genetic algorithms, Evolutionary strategy, Evolutionary Programming, Genetic programming. Genetic Algorithm and Genetic Programming: Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.	10 lectures
Unit III	Swarm Optimization: Introduction to Swarm intelligence, Ant colony optimization (ACO), Particle swarm optimization (PSO), Artificial Bee colony algorithm (ABC), Other variants of swarm intelligence algorithms.	7 lectures
Unit IV	Advances in Soft Computing Tools: Fuzzy Logic, Theory and applications, Fuzzy Neural networks, Pattern Recognition, Differential Evolution, Data Mining Concepts, Applications of above algorithms in manufacturing engineering problems. Artificial Neural Networks: Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Back propagation algorithm, factors affecting back propagation training, applications.	10 lectures
Unit V	Application of Soft Computing to Mechanical Engineering/Production Engineering Problems: Application to Inventory control, Scheduling problems, Production, Distribution, Routing, Transportation, Assignment problems	7 lectures
Books: <ol style="list-style-type: none"> 1. Tettamanzi Andrea, Tomassini and Marco, Soft Computing Integrating Evolutionary, Neural and Fuzzy Systems, Springer, 2001. 2. Elaine Rich, Artificial Intelligence, McGraw Hill, 2/e, 1990. 3. Kalyanmoy Deb, Multi-objective Optimization using Evolutionary Algorithms, John Wiley and Sons, 2001. 		

EE13043	Energy Efficiency and Audit: 3 Credits (3-0-0)	
Unit I	Introduction to Energy Efficiency: Energy Scenario: Energy demand and supply, National scenario. Energy Efficiency and Energy Conservation; concepts, Indian Electricity Act 2001; relevant clauses of energy conservation. BEE and its Roles. Star Labelling: Need and its benefits. Pumping Systems, Fans and Blowers: Factors affecting pump performance. Efficient Pumping system operation, Energy conservation opportunities in Pumping systems, Fan types, flow control strategies, Fan performance Assessment, Energy Conservation opportunities in Pumping systems, Tips for energy saving in fans and blowers.	10 lectures
Unit II	Air Compressors and Diesel Power Generator Sets: Classification of compressors Pneumatic System components. Effect of various parameters on efficiency of Compressor. Capacity control of Compressors. Checklist for Energy Efficiency in Compressed air systems. Operating guidelines for diesel generator, operational factors Effects of improper ventilation of genset. Energy saving measures for DG sets.	8 lectures
Unit III	Energy Conservation in Lighting System: Replacing Lamp sources. Using energy efficient luminaries. Using light controlled gears. Installation of separate transformer / servo stabilizer for lighting. Periodic survey and adequate maintenance programs Innovative measures of energy savings in lighting.	7 lectures
Unit IV	Energy Efficient Electrical Machines: Need for energy conservation in induction motor and transformer. Energy conservation techniques in induction motor by: Energy conservation techniques in Transformer. Energy Conservation Equipment: Soft starters, Automatic star delta convertor, Variable Frequency Drives, Automatic p. f. controller (APFC). Energy efficient motor; significant features, advantages, applications and Limitations, Energy efficient transformers, amorphous transformers; epoxy Resin cast transformer / Dry type of transformer. Aggregated Technical and commercial losses (ATC), Technical losses; causes and measures to reduce, Commercial losses: pilferage, causes and remedies. Application of tariff system to reduce energy bill, Co-generation and Tariff; concept, significance for energy conservation.	10 lectures
Unit V	Energy Audit of Electrical Systems: Energy audit (definition as per Energy Conservation Act). Energy audit instruments and their use. Questionnaire for energy audit projects, Energy flow diagram (Sankey diagram). Simple payback period, Energy Audit procedure (walk through audit and detailed audit). Energy Audit report format.	7 lectures

Books:

1. Guide Books No. 1 and 3 for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency (BEE), Bureau of Energy Efficiency (A Statutory body under Ministry of Power, Government of India) (Fourth Edition 2015).
2. O.P. Gupta, Energy Technology, Khanna Publishing House, Delhi, Edition 2018, (ISBN: 978-93-86173-683).
3. Henderson, P. D., India - The Energy Sector, University Press, Delhi, 2016. ISBN: 978-0195606539.
4. Turner, W. C., Energy Management Handbook, Fairmount Press, 2012, ISBN 9781304520708.
5. Sharma, K. V., Venkateshaiah, P., Energy Management and Conservation, I K International Publishing House Pvt. Ltd; 2011 ISBN 9789381141298.
6. Mehta, V. K., Principles of Power System, S. Chand and Co. New Delhi, 2016, ISBN 9788121905947.
7. Singh, Sanjeev; Rathore, Umesh, Energy Management, S K Kataria and Sons, New Delhi ISBN-13: 9789350141014.
8. Desai, B. G.; Rana, J. S.; A. Dinesh, V.; Paraman, R., Efficient Use and Management of Electricity in Industry, Devki Energy Consultancy Pvt. Ltd.
9. Chakrabarti, Aman, Energy Engineering and Management, e-books Kindle Edition.

EE13044	Artificial Intelligence: 3 Credits (3-0-0)	
Unit I	Introduction to Artificial Intelligence: Artificial Intelligence (AI) definition, Goals of AI, History of AI, Applications of AI.	4 lectures
Unit II	Agents and Environments: Agent Terminology, Types of Agents – Simple Reflex Agents, Model Based Reflex Agents, Goal Based Agents, Nature of Environments,	7 lectures

	Properties of Environments.	
Unit III	Search Algorithms Terminology: Brute Force Search Strategies – Breadth First Search, Depth First Search. Heuristic Search Strategies, Local Search Algorithms.	7 lectures
Unit IV	Fuzzy Logic Systems: Introduction to Fuzzy Logic and Fuzzy systems, Membership functions, Fuzzification/Defuzzification	12 lectures
Unit V	Neural Networks: Basic structure of Neural Networks, Perceptron, Back-propagation	12 lectures
Books:		
1. Artificial Intelligence By Example: Develop machine intelligence from scratch using real artificial intelligence use cases Denis Rothman Packet Publishing ISBN – 978-1788990547.		

EE13045	Solar Power Technologies: 3 Credits (3-0-0)	
Unit I	Solar Energy: Solar Map of India: Global solar power radiation, Basics of Solar cell, solar PV Module, series and parallel connection of PV modules and solar cell parameters and IV characteristics.	7 lectures
Unit II	Different types of Solar water heaters: Construction, working, specifications and installation, Solar Heating systems, Solar drying and different types of Solar cookers, Solar lighting. Preventive maintenance of all of the above.	8 lectures
Unit III	Concentrated Solar Power (CSP): Concentrated Solar Power (CSP) plants or solar thermal electric systems, Parabolic Trough: Construction, working and specifications. Parabolic Dish: Construction, working and specifications. Power Tower, Fresnel Reflectors: Construction, working and specifications. Solar Stirling engines, Preventive maintenance of all of the above.	9 lectures
Unit IV	Solar PV Electronics: Solar Charge controllers: working and specifications, switchgear and cables. Batteries: Different types for solar PV systems, maintenance and specifications. Solar Inverters: working and specifications. Signal conditioning systems: working and specifications. Solar Power tracking: construction, working, tilt angle, solar radiation, I-V, P-V characteristics, maximum power point tracking (MPPT), Maintenance of these systems.	9 lectures
Unit V	Solar PV Off-Grid and Grid Tied Systems: Solar off grid systems: layout and specifications. Solar Grid tied (on grid) systems: Working principle of grid-tied dc-ac inverter, grid synchronization and active power export. Net metering: main features and working. Solar-wind Hybrid systems: Layout and specifications.	9 lectures
Books:		
1. Solanki, Chetan Singh, - Solar Photovoltaics: Fundamentals, Technologies and Applications, PHI Learning, New Delhi, ISBN: 9788120351110.		
2. Solanki, Chetan Singh, - Solar Photovoltaic Technology and Systems - A Manual for Technicians, Trainers and Engineers, PHI Learning, New Delhi, ISBN: 9788120347113.		
3. Kothari, D.P. et al., Renewable Energy Sources and Emerging Technologies, PHI		
4. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd, - Renewable Energy Systems, Pearson Education New Delhi, ISBN: 9789332586826.		
5. Rachel, Sthuthi, Earnest, Joshua; -Wind Power Technologies, PHI Learning.		
6. O.P. Gupta, Energy Technology, Khanna Publishing House, ISBN: 978-93-86173-683.		

EE13046	Wind Power Technologies: 3 Credits (3-0-0)	
Unit I	Wind Energy and Wind Power Plants: Wind power scenario in the world and India. Characteristics of Wind Energy: Wind movement, wind profile, roughness, effects of obstacles in wind path. Types of Wind Power Plants (WPPs): Small and large wind turbines; Horizontal and Vertical axis; Upwind and Downwind, One, Two and Three blades; constant and variable Speed; Geared, Direct-Drive and Semi-Geared (Hybrid) WPPs; WECS, WEGs, WTs, WPPs, WPP Tower Types: Lattice; tubular: steel, concrete, hybrid, ladders, cables. WPP substation: Switchgear, transformers, inside layouts of Electric electronic panels at block level.	9 lectures
Unit II	Construction and Working of Large Wind Power Plants: Wind Turbine Terminologies: Cut-in, cut-out and survival wind speeds, Threshold wind speeds, rated power, nominal power, Wind Power Curve, Major Parts and Functions of WPP: Rotor blades, hub, nacelle, tower, electric sub-station, nacelle layouts of Geared, Direct-Drive and Semi-Geared WPPs, Main shaft, gearbox, electric generator, electronic control	9 lectures

	panels. Rotation Principles: Drag and Lift principle, thrust and torque of wind turbine rotor. Different Types of Sensors: Anemometer, wind vane, rpm sensors of main shaft and generator, temperature sensors of nacelle, gearbox and generator; cable untwisting and vibration sensors. Different Types of Actuators: Electric and hydraulic pitching and yawing mechanisms, cable untwisting and braking mechanisms	
Unit III	Aerodynamic Control, Electric Generators and Grid Connection: Aerodynamic Control of WPPs: Stall Pitch and Active Stall. Braking mechanisms of large WPPs. Electric Generator Types: Working of Squirrel-Cage rotor Induction Generator (SCIG), Wound-Rotor Induction Generator (WRIG), Doubly-Fed Induction Generator (DFIG), wound rotor and permanent magnet synchronous generators. Electric grid connection of WPPs: Local Impacts and system wide impact.	8 lectures
Unit IV	Construction and Working Small Wind Turbines: Types and working of different type of small wind turbines (SWT): Classification: Horizontal and Vertical axis, Upwind and Downwind, One, Two and Three blades; Constant and Variable Speed; Direct-Drive and Geared; braking of SWTs Parts of SWTs: Rotor, generator, gearbox, tower, electric control panel, tale vane, anemometer, wind vane, temperature and rpm sensors. Working SWTs: Direct-drive and Geared. Electrical generators in SWTs: permanent magnet synchronous generators, induction generators SWT towers: Lattice tubular type, hydraulic towers, ladders and cables.	8 lectures
Unit V	Maintenance of Small Wind Turbines: Small wind turbine assembly. Installation of different types of small wind turbines (SWT): tubular and lattice types. SWT Routine maintenance: Tips; Preventive maintenance schedule of: braking mechanisms, sensors; oiling and greasing related; electric and electronic equipment related; tower related; software related, minor repairs. Power electronic devices and converters in different types of SWTs: thyristors, power transistors Common electrical and mechanical faults in SWTs. Maintenance of Small Wind Turbines: Small wind turbine assembly. Installation of different types of small wind turbines (SWT): tubular and lattice types. SWT Routine maintenance: Tips; Preventive maintenance schedule of braking mechanisms, sensors; oiling and greasing related; electric and electronic equipment related; tower related; software related, minor repairs Power electronic devices and converters in different types of SWTs: thyristors, power transistors, Common electrical and mechanical faults in SWTs.	8 lectures
Books: <ol style="list-style-type: none"> 1. Hau, Erich: Wind Turbines Springer-Verlag, Berlin Heidelberg, Germany, ISBN: 978-3-642-27150-2. 2. Rachel, Sthuthi, Earnest, Joshua; -Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9. 3. Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304. 4. Wizelius, Tore, Earnest, Joshua - Wind Power Plants and Project Development, PHI Learning, New Delhi, ISBN:978-8120351660. 5. Bhadra, S.N., Kastha, D., Banerjee, S, Wind Electrical Systems installation; Oxford University Press, New Delhi, ISBN: 9780195670936. 6. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi (ISBN: 978-93-86173-683). 		

DEPARTMENT OF MECHANICAL ENGINEERING

Year I Semester I						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	HS11101	Remedial English – I	2	0	2	03
2.	PH11101	Physics – I	3	0	2	04
3.	CY11101	Chemistry – I	3	0	2	04
4.	MA11101	Mathematics – I	3	1	0	04
5.	ES11151	Engineering Drawing	0	0	6	03
6.	ES11152	Workshop Practice	0	0	4	02
Total						20

Year I Semester II						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	HS11201	Remedial English – II	2	0	2	03
2.	PH11201	Physics – II	3	0	2	04
3.	CY11201	Chemistry – II	2	0	2	03
4.	MA11201	Mathematics – II	3	1	0	04
5.	ES11200	Basic Electrical and Electronics Engineering	3	0	2	04
6.	ME11251	Mechanical Drawing	1	0	4	03
Total						21

Year II Semester III						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	MA12101	Mathematics – III	3	1	0	04
2.	ES12100	Basics of Computer and Programming	2	0	2	03
3.	ME12101	Welding, Foundry and Forging	3	0	2	04
4.	ME12102	Materials and Shop Theory	2	0	4	04
5.	ME12103	Refrigeration and Air Conditioning	3	0	2	04
6.	ME12104	Automobile Servicing	3	0	2	04
7.	ME12105	Machine Elements and Machine Tools	3	0	0	03
Total						26

Year II Semester IV						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	ES12201	Technical Mechanics	3	1	0	04
2.	ME12201	Machine Maintenance	3	0	2	04
3.	ME12202	Strength of Materials	3	0	2	04
4.	ME12203	Refrigeration and Air-conditioning Equipments	3	0	0	03
5.	HS12201	Fundamentals of Entrepreneurship	3	0	0	03
6.	HS12277	Essence of Indian Traditional Knowledge (Audit)	2	0	0	00
7.	ME12279	Winter Internship	0	0	0	03
8.	ED12288	Extra-Curricular Activities and Discipline	0	0	0	02
Total						23

Year III Semester V						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	ME13101	Design of Machine Elements	3	0	2	04
2.	ME13102	Thermal Engineering	3	0	2	04
3.	ME13103	Measurements and Metrology	2	0	2	03
4.	ME130**	Programme Elective – I	3	0	0	03
5.	ME130**	Programme Elective – II	3	0	0	03
6.	**1304*	Open Elective – I	*	*	*	03
7.	ME13199	Project – I	0	0	2	01
Total						21

Year III Semester VI						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	ME13201	Fluid Mechanics and Machines	3	1	2	05
2.	ME13202	Theory of Machines	3	0	2	04
3.	ME130**	Programme Elective – III	3	0	0	03
4.	**1304*	Open Elective – II	*	*	*	03
5.	**1304*	Open Elective – III	*	*	*	03
6.	HS13277	Indian Constitution (Audit)	2	0	0	00
7.	ME13289	Seminar	0	0	2	01
8.	ME13299	Project – II	0	0	6	03
Total						22

LIST OF ELECTIVES

Programme Electives – I& II						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	ME13001	Automobile Engineering	3	0	0	03
2.	ME13002	Mechatronics	3	0	0	03
3.	ME13003	Tool Engineering	3	0	0	03
4.	ME13004	Advanced Manufacturing Processes	3	0	0	03
5.	ME13005	Industrial Engineering and Management	3	0	0	03
6.	ME13006	Heat Transfer	3	0	0	03

Programme Elective – III						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	ME13011	Production and Operations Management	3	0	0	03
2.	ME13012	Computer Aided Design and Manufacturing	3	0	0	03
3.	ME13013	Alternate Energy Sources and Management	3	0	0	03
4.	ME13014	Material Handling System	3	0	0	03
5.	ME13015	Industrial Robotics and Automation	3	0	0	03

Open Elective – I						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	ME13041	Mechatronics	3	0	0	03

Open Elective – II/III						
S. N.	Course Code	Course Title	L	T	P	Credit
1.	ME13042	Computer Aided Design and Manufacturing	3	0	0	03

COURSE CONTENT

ES11152	Workshop Practice: 2 Credits (0-0-4)
Unit I	Carpentry Shop: Introduction to carpentry and safety aspects; use of different tools (functions, types and specifications) types of woods, hand tools and wood working machines. Practice on simple carpentry joints.
Unit II	Fitting shop: Introduction to fitting practice and safety aspects; use of different tools (functions, types and specifications); Practice on filing, hack sawing, drilling and tapping; Fitting practices.
Unit III	Welding Shop: Introduction hand tools (functions, types and specifications) and safety aspects; arc welding process: practice on welding joints.
Unit IV	Sheet metal Shop: Introduction to sheet metal tools (functions, types and specifications); practice on sheet metal operations and joints. Preparation simple jobs like clamp, funnel, cabinet, etc. employing cutting, folding, drilling, riveting etc.
Unit V	Smithy shop: Standard material available for smithy works, manufacturing chisel and hexagonal bolt, chain link manufacturing, practice in forging, operation, drawing, upsetting and swaging punching.

Books:

1. Rao, P.N., Manufacturing Technology (Vol. I), McGraw Hill Education Pvt. Ltd., 2007.
2. Pandey, P.C. and Singh, C.K., Production Engineering Sciences, Standard Book Publishers, 2011.
3. Hajra Choudhary, S. K., Hajra Choudhary, A.K. and Roy, N., Elements of Workshop Technology (Vol I & II), Media Promoters & Publishers Pvt. Ltd., 2007.
4. Ghosh, A. & Mallik, A. K. Manufacturing Science, East West Press, 1993.
5. Parmar, R. S., Welding Processes and Technology, Khanna Publishers, 2003.

ME11251	Mechanical Drawing: 3 Credits (1-0-4)
Unit I	Introduction to I.S. codes, limits, fits and tolerances, conventional drawing symbols, surface finish, materials, abbreviations in drawing, machine components, welding symbols, instruments symbols
Unit II	Orthographic projection to isometric projection, isometric projection to orthographic projections, missing views, sectional view: half, full, partial, aligned sectioning, blue print reading, free hand sketching.
Unit III	Mechanical element: screw threads, bolts & nuts, studs, rivets, keys.
Unit IV	Assembly elements: couplings, cotters, other joints.
Unit V	Assembly drawing of engine/ machine tool/ miscellaneous assemblies.

Books:

1. Narayana, K.L., Kannaiah, P. & Venkata Reddy, K., Machine Drawing, New Age Int. Pub., 3rd Ed., 2014.
2. Siddeswar, N. & Kannaiah, P., Machine Drawing, McGraw Hill Int., 2nd Ed., 2010.
3. Narayana, K.L., Kannaiah, P. & Venkata Reddy, K., Production Drawing, New Age Int. Pub., 3rd Ed., 2014.

ME12101	Welding, Foundry and Forging: 4 Credits (3-0-2)	
Unit I	Welding; Classification/different types of welding; Compatible materials for welding joints; Arc and gas welding equipments & safety measures, different welding joints and their uses; welding techniques; Introduction to thermit welding, forge welding, spot welding, MIG and TIG welding.	10 Lectures
Unit II	Different types of electrodes and their specifications; flux, flux materials & properties of fluxes; Welding symbols; Welding defects, Testing of welds. Weld inspection; Introduction to soldering and brazing.	08 Lectures
Unit III	Introduction to foundry tools and equipments, pattern making, pattern materials and allowances, types of patterns, segmentation in pattern making. Moulding and core making processes, moulding materials and their properties.	08 Lectures
Unit IV	Gating and risering, Melting and pouring techniques, fettling of casting, inspection and heat treatment of castings and casting defects.	08 Lectures

Unit V	Introduction to forging tools and equipments, safety in forging, forging operations, recrystallisation, slip and twinning, Machines used in forging, equipments used, hammer forging, drop forging, press forging, liquid forging, forging die design and forging defects.	08 Lectures
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Books:

1. Rao, P.N., Manufacturing Technology (Foundry, Forming and Welding), 2nd Ed., Tata McGraw Hill publishing House, 2007.
2. Hajra Choudhary, S. K., Hajra Choudhary, A.K. and Roy, N., Elements of Workshop Technology (Vol. I & II), Media Promoters & Publishers Pvt. Ltd., 2007.
3. Nagendra Prashar, B.S. and Mittal, R.K., Elements of Manufacturing Processes, Eastern Economy Edition, 2007.
4. Lal, G.K. and Choudhury, S.K., Fundamentals of Manufacturing Processes, Narosa publishing House, 2010.

ME12102 Materials and Shop Theory: 4 Credits (2-0-4)

Unit I	Engineering materials, its classification and properties. Ferrous materials: iron and steel. Percentage of carbon in steels. Heat treatment of metals. Designation of iron and steel. Tool and die steels.	06 Lectures
Unit II	Non-ferrous material: Copper and its alloys. Aluminium and its alloys. Zinc and its alloys. Ceramics, their properties, usage and fabrication. Composite materials and their classification. Matrix and reinforcements in Composites.	06 Lectures
Unit III	Engineering plastics, thermoplastics and thermosets. Behaviour of plastics. Plastic processing. Casting process. Molding and core making. Pattern making	06 Lectures
Unit IV	Machining and machine shop. Lathe and its operations. Lathe accessories. Drilling machine. Shaping machine. Milling machine.	06 Lectures
Unit V	Limits, fits and tolerances. Standards and measurements. IS symbols and codes. Symbols of fasteners.	04 Lectures

Books:

1. Hajra Choudhary, S. K., Hajra Choudhary, A.K. and Roy, N., Elements of Workshop Technology (Vol I & II), Media Promoters & Publishers Pvt. Ltd., 2007.
2. Anderson, J. & Tatro, E., Shop Theory, Tata McGraw-Hill, 6th Ed., 1990.
3. Rao, P.N., Manufacturing Technology: Foundry, Forming and Welding, Tata McGraw Hill, 3rd Ed., 2014.
4. Campbell, J.S., Principles of Manufacturing Materials and Processes, Tata McGraw Hill, 1961.

ME 12103 Refrigeration and Air Conditioning: 4 Credits (3-0-2)

Unit I	Introduction to Refrigeration: Definition of refrigeration and necessity of refrigeration, different methods of refrigeration process such as ice refrigeration, air refrigeration system, vapour refrigeration system, etc, Concept of heat engine, heat pump and refrigerator. Unit of refrigeration, C.O.P. and refrigerating effect. Major application areas of R.A.C. like domestic, commercial and industrial.	08 Lectures
Unit II	Refrigeration Cycles: Reversed Carnot Cycle and its representation on PV and TS diagram. Air refrigeration system, Bell Coleman air refrigerator, its representation on PV and TS diagram, types and applications like aircraft refrigeration using simple air-cooling system. Vapour Compression refrigeration system, principle, components, representation on P-H and T-S diagram, effects of wet compression, dry compression, calculation of COP, Effect of superheating, sub cooling. Working principle of vapour absorption system	12 Lectures
Unit III	Refrigerants: classification of refrigerants. Desirable properties of refrigerants Nomenclature of refrigerants, Selection of refrigerant for specific applications, Concept of Green House Effect, Ozone depletion, Global warming, Eco-friendly refrigerants like R-134a, hydrocarbon refrigerants etc.	04 Lectures
Unit IV	Psychrometry: Definition and necessity of air conditioning. Properties of Air, Dalton's law of partial pressure Psychrometric properties, Psychrometric chart, Psychrometric processes, Psychrometers, bypass factor, ADP, concept of SHF, RSHF, ERSHF, GSHF, adiabatic mixing of air streams Simple numerical using Psychrometric chart. Comfort conditions and principles of cooling load calculations, Factors affecting human comfort, Effective temp. and comfort chart, Components of cooling load- sensible heat gain and latent heat gain sources	12 Lectures

Unit V	Air-conditioning Systems: Classification of A.C. systems Industrial and commercial A.C. systems Summer, winter and year-round A.C. systems Central and unitary A.C. systems Application areas of A.C. systems. Components of air distribution systems, duct systems, losses in ducts, fans and blowers types, working, Air distribution outlets, return outlets, grills, diffusers, Purpose of insulation, properties of insulating material, types of insulating materials.	06 Lectures
Books:		
<ol style="list-style-type: none"> 1. Arora and Domkundwar, Refrigeration and Air Conditioning, Dhanpat Rai and Sons, 2016. 2. Prasad, Manohar, Refrigeration and Air Conditioning, New Age Publications, 2009. 3. Ananthanarayanan, P.N., Refrigeration and Air Conditioning, , McGraw Hill Education; Fourth edition, 2013. 4. Dossat, Roy, Principles of Refrigeration, Pearson Education 5th Edition, 2001. 5. Anderson, Edwin P., Commercial Refrigeration, Taraporevala Sons & Co, 1970. 		

ME12104 Automobile Servicing: 4 Credits (3-0-2)		
Unit I	<p>Introduction: Automobile and its classifications</p> <p>Frame and Suspension: Chassis classification based on layout of power system locations and drive, constructional details of various types of frames, functions. Principles of suspension system, front and rear suspension system, function and types of torque rod, springs and shock absorbers.</p> <p>Power transmission systems: Function, principles of operation and main components of clutch, types of clutches, clutch lining material. Principles of gearing, types of gear box and their functions, propeller shaft, Universal joint, differential, rear axle</p>	09 Lectures
Unit II	<p>Steering and front axle: Constructional details and classification of front axle. Front wheel geometry viz. Castor, Camber, King pin inclination, Toe-in. Conditions for true rolling motion of wheels during steering, steering geometry, Ackerman and Davis steering system. Constructional details of steering linkages.</p> <p>Wheels and tyres: Types of wheels, rims, tyres and tube. Constructional and working details of tyres and their selection, ordinary, radial and tubeless tyres, Wear of tyres-cause and remedy, wheel balancing</p> <p>Braking systems: Classification of brakes, drum brakes and disc brakes, constructional details, introduction to hydraulic brake, parking brake, vacuum assisted hydraulic brakes, compressed air assisted brakes, leading and trailing brake shoes, working of master cylinders, wheel cylinders, brake pedal adjustment.</p>	12 Lectures
Unit III	<p>Hydrodynamic drive: Fluid coupling: Principle of operation, constructional Details. Torque Converter: Principle of operation, constructional details, performance characteristics, converter coupling</p> <p>Engine construction: Two stroke and four stroke engine construction, cylinder, cylinder head, piston, piston ring, crank shaft, crank pin, connecting rod, Fly wheel, valve mechanism, tappet clearance, end bearing. Bore and stroke, piston displacement, compression ratio, volumetric efficiency,</p> <p>Engine fuel and systems: Engine fuels and their classifications, Air and solid injection, function of components, injector Fuel injectortypes of injection nozzle, injection timing. SI Engine Fuel System: Carburetor working principle, Fuel feed systems. Mechanical and Pneumatic governors.</p>	10 Lectures
Unit IV	<p>Combustion and engine performance: Combustion on SI and CI engine, knock in CI and SI engine, Cetane and Octane number, Air-fuel ratio, Supercharging and Turbo charging. Engine performance analysis, power, torque and speed of engine, calculations. Morse test.</p> <p>Cooling and lubricating System: Need for cooling system, types of cooling system, liquid cooled system, thermo syphon system and pressure cooling system. Lubrication system, mist lubrication, wet sump and dry sump lubrication. Properties of lubricants and coolants.</p>	06 Lectures
Unit V	Automotive electrical systems: Functions and types of storage batteries, principles and construction of lead-acid battery, characteristics of battery, rating capacity and efficiency of batteries, charging methods. Conventional ignition	05 Lectures

	systems, types, construction & working of battery coil and magneto ignition systems, types and construction of spark plugs, electronic ignition system. Functions of starting system, principle & construction of starter motor. Working of different starter drive units	
Books:		
<ol style="list-style-type: none"> 1. Gillespie, Thomas D., Fundamentals of Vehicle Dynamics, Society of Automotive Engineers, 1992. 2. Heitner, Joseph, Automotive Mechanics, CBS, 2nd Ed, 2004. 3. Crouse, William H. and Anglin, Donald L., Automotive Mechanics, 10th Ed (2006) Special Indian Edition, Tata McGraw Hill. 4. Singh, Kirpal, Automobile engineering (Vol. - I & II), Standard Publishers, 14th Ed, 2018. 5. Srinivasan, S., Automotive Mechanics, Tata McGraw Hill, 2nd Ed, 2003. 		

ME12105 Machine Elements and Machine Tools: 3 Credits (3-0-0)		
Unit I	Introduction to Machine tools, classifications, work-tool motions of common machine tools. Lathe: working principle, classifications, specifications, various parts, and its mechanism; Lathe operations: plain turning, taper turning, thread cutting, knurling; Work holding devices, accessories and attachments. Process parameters and its important: cutting speed, feed and depth of cut, machining time evaluation, Taper turning and thread cutting calculation. Defects & remedies in lathe operations.	08 Lectures
Unit II	Drilling machine: working principle, classifications, specifications, various parts & its mechanism of common drilling m/cs. Drilling machine operations. Tap -drill size. Gang and multi spindle drilling. Process parameters and drilling time calculation.	08 Lectures
Unit III	Shaping machine: working principle, classifications, specifications, shaper mechanisms: reciprocating, quick return, stroke length adjustment, & feed mechanism; shaper operations: plain, angular, dovetail, t-slot, key-way cutting, contour, estimation of cutting speed & machining time, hydraulic shaper: its principle & advantages, shaper vs planner, slotter	10 Lectures
Unit IV	Milling machine: working principle, classifications & specifications Construction of Column & knee type milling machine, Vertical milling machine, etc. Milling operations: plain, angular, face, straddle, gang, key-way cutting & spur gear cutting. Milling cutters. Cutting speed, feed, and machining time evaluation.	08 Lectures
Unit V	Introduction to grinding machines: classifications & its constructions; different grinding operations. Use of Cutting fluids: types, applications & its selection. Qualities of good cutting fluids. Measuring instruments (construction, types, and applications): Vernier calliper, micrometer, and dial gauge. Errors in measurements and remedies.	08 Lectures
Books:		
<ol style="list-style-type: none"> 1. Hajra Choudhary, S. K., Hajra Choudhary, A.K. and Roy, N., Elements of Workshop Technology (Vol I & II), Media Promoters & Publishers Pvt. Ltd., 2007. 2. Raghawangshi, Workshop Technology (Vol II), Dhanpat Rai, 2016. 3. Sharma, P. C., Production Technology (manufacturing processes), S. Chand, 7th Ed, 2006 . 4. Jain, R.K., Production Technology, Khanna Publishers, 17th Edition, 2014. 5. Pollak, Herman. W., Manufacturing and Machine Tool Operation, Prentice Hall Inc., 2nd Ed., Mar 1979. 		

ES12201 Technical Mechanics: 4 Credits (3-1-0)		
Unit I	Inertial and Non-inertial frames of reference; Free Body Diagram; Internal and External forces; Force systems; Concept of moment, equilibrium principles; Equilibrium of concurrent and co planer force systems; equilibrium of bodies in space, Laws of Mechanics. Tutorials.	08 Lectures
Unit II	Types of structures, Supports and support reactions: Method of Joints, Method of Sections. Tutorials. Static Analysis of systems with friction: Friction and impending motion, rolling resistance, Wedge friction. Tutorials	10 Lectures
Unit III	Centroid, centre of mass, centre of gravity, concept of first moment, centroid of a	08 Lectures

	length, centroid of an area, Theorem of Pappus and Guldinus, centroid of a volume etc., Moment of Inertia: parallel axes theorem and perpendicular axis theorem. Tutorials	
Unit IV	Kinematics of Rigid Body: Types of motion, fixed axis rotation, plane motion of a rigid body, instantaneous centre of rotation, relative velocity and acceleration for points on a rigid body. Tutorials.	08 Lectures
Unit V	Dynamics of a Rigid Body: D'Alembert's principle, translation of a rigid body, rotation of a rigid body about a fixed principal axis, plane motion of a rigid body, general motion of a rigid body. Projectiles and SHM; Impact of elastic bodies: Co-efficient of restitution. Tutorials.	08 Lectures

Books:

1. Shames, H., Engineering Mechanics: Statics and Dynamics, 4th Ed, PHI, 2002.
2. Beer, F. P. and Johnston, E. R., Vector Mechanics for Engineers, Vol I - Statics, Vol II – Dynamics, Tata McGraw Hill, 9th Ed, 2011.
3. Meriam, J. L. and Kraige, L. G., Engineering Mechanics, Vol I – Statics, Vol II – Dynamics, John Wiley, 6th Ed, 2008.
4. Hibbler, R. C., Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press, 2006.
5. Ruina, A. and Rudrapratap, Introduction to Statics and Dynamics, Oxford University Press, 2011.
6. Bansal, R.K., and Bansal, S., A Textbook of Engineering Mechanics, Laxmi Publication, 2015.

ME12201 Machine Maintenance: 4 Credits (3-0-2)		
Unit I	Introduction to maintenance engineering, Concept of breakdown maintenance and preventive maintenance, classification of machines based on maintenance requirements, repair cycle of various machines, repair complexity, depreciation and machine life.	10 Lectures
Unit II	Periodic maintenance of machine tool components like tailstock, three jaw chuck, lead screw and nut, machine spindles and guide surfaces; repair methods.	10 Lectures
Unit III	Limits, fits and tolerances, Maintenance, problems and repairing aspects of threads and threaded joints, power transmission system: belt drives, gears and gear transmission, gear trains, heat treatment of materials.	08 Lectures
Unit IV	Maintenance of machine tool accessories: lathe, drilling machines, shaping machine and milling machine; repair methods, etc.	06 Lectures
Unit V	Maintenance of Miscellaneous equipments like pumps, compressors, engines, valves, piping systems, machine hydraulics; suggest appropriate repair methods. Preventive & schedule maintenance of pumps. Gland packing changing procedure. Concept of Mechanical seal Trouble shooting in pump.	08 Lectures

Books:

1. Garg, H.P., Industrial Maintenance, S. Chand & Company Limited, 6th Ed., 2008.
2. Mobley, R.K., Maintenance Engineering Handbook, Mc-Graw Hill Education, 8th Ed., 2014.
3. Richardson, D.C., Plant Equipment and Maintenance Engineering Handbook, Mc-Graw Hill Education, 2014.
4. Hajra Choudhary, S. K., Hajra Choudhary, A.K. and Roy, N., Elements of Workshop Technology (Vol I & II), Media Promoters & Publishers Pvt. Ltd., 2007.
5. Anderson J. & Tatro, E., Shop Theory, Tata McGraw-Hill, 6th Ed., 1990.

ME12202 Strength of Materials: 4 Credits (3-0-2)		
Unit I	Types of loads, Simple stresses & strains viz. tensile, compressive, Shear, Crushing, Thermal stresses, Hoop stresses & corresponding strains, Volumetric Strain, Hook's law, stress-strain curves for ductile & brittle materials, Analysis of bars of varying sections. Elastic constant and their relations.	08 Lectures
Unit II	Definition of principal plane & principal stresses. Expression for normal and tangential stress, maximum shear stress. Stresses on inclined planes. Position of principal planes & planes of maximum shear.	08 Lectures
Unit III	Shear force, bending moment & their relation. Shear force and bending moment diagrams for simply supported beam & cantilevers subjected to point loads & Uniformly distribution load, concept of Uniformly varying load & couples acting on beam.	08 Lectures

Unit IV	Strain energy Concept, derivation & expression for deformation (axially loaded members: under gradual, sudden & impact load). Strain energy due to self-weight. Theory and Assumptions of simple bending. Concepts of Deflection & slope of beams – relation between bending moment & slope. Deflection of different beams under various loading systems.	10 Lectures
Unit V	Concept of Pure Torsion, Torsion equation for solid and hollow circular shafts. Assumptions in theory of pure Torsion. Concepts of Buckling – Rankine's & Euler's formulae for buckling load for columns / shafts under compression, concepts of equivalent length for various end conditions.	08 Lectures
Books:		
<ol style="list-style-type: none"> 1. Rajput, R.K., Strength of Materials, S.Chand & Co, 6th Ed, 2015. 2. Rattan, S.S., Strength of Materials, TMH, 2nd Ed, 2009. 3. Punmia, B.C., Strength of Materials, Firewall Media, 2002. 4. Srivastava, A. K. and Gope, P.C., PHI, 2nd Edition, 2012. 5. Bansal, R. K., Text Book of strength of Material, Laxmi Publication, 6th Ed, 2018. 		

ME12203	Refrigeration and Air Conditioning Equipments: 3 Credits (3-0-0)	
Unit I	Refrigeration tools and materials: Tubing and piping materials and their specifications, copper tube practices – cutting, bending, flaring, swaging, brazing, pinching, tube and pipe fittings, instrument and gauges, different types of valves, gaskets, refrigerant cylinders and their handling, human safety.	06 Lectures
Unit II	Compressors: Type of compressor - reciprocating (Semi hermetic, hermetic and open types), rotary, centrifugal and screw type, compressor construction, p–V diagram of compressor, working of compressor, volumetric efficiency of compressor, lubrication of compressor, Cooling of compressor and windings, mufflers. Condensers: Types of condensers – air cooled, water cooled and evaporative, condensing temperature, condenser load, heat rejected factor, fouling of condenser, use of cooling tower in condenser.	12 Lectures
Unit III	Throttling or expansion devices: Types of expansion devices, construction and operation of automatic and thermostatic expansion valves, capillary tubes, float valves, testing and adjusting thermostatic expansion valves, solenoid valves, electronic TEV. Evaporators: functions and types of evaporators -dry and flooded, bare and finned type, heat absorbed in evaporators, chillers, different types of chillers method of defrosting. Other components: receivers, accumulators, driers.	10 Lectures
Unit IV	Air conditioner components: functions and classifications of fans, filters, humidifiers, heating and cooling coils, ducts, grills, resistors, dampers, turning vanes, anemometer, hygrometer, etc.	07 Lectures
Unit V	Controls: functions and elements of control, sensing elements-bimetallic, bulb and bellow, solenoids, electric resistance type etc. actuating element thermostat, humidistat, pressure stats etc., modulating motors, construction and operation, bypass controls, use of chokes for controlling fan motor speeds. Starter capacitors, HP and LP controls, oil failure safety switches, power element testing.	07 Lectures
Books:		
<ol style="list-style-type: none"> 1. Ananthanarayanan, P. N., Basic Refrigeration and Air Conditioning, Tata McGraw Hill, 4th Ed., 2015. 2. Dossat, R. J., Principles of Refrigeration, Pearson Education, 4th Ed., 2002. 3. Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2002. 4. Pita, Edward G., Air Conditioning Principles and Systems, , Pearson Education, 3rd Ed., 1998. 		

ME13101	Design of Machine Elements: 4 Credits (3-0-2)	
Unit I	Introduction to design and its classification, basic design procedure, standards and codes, engineering materials and its classification, stress – strain diagram, selection of failure theories, design of simple machine parts.	06 Lectures
Unit II	Design of power screws: Dynamics of power screws, Self-locking requirements, Material selection and design calculations. Belt drives: Typical applications and	08 Lectures

	comparison with chain drive, material selection and design calculations, commercial designations of belts.	
Unit III	Design of joints: Temporary and permanent joints, applications and limitations. Riveted joints, Bolted joints and Welded joints, Designations and symbols. Knuckle and Cotter joints. (Elementary design considerations only, pre-stressing, caulking etc. excluded).	08 Lectures
Unit IV	Design of shafts, keys and couplings under unidirectional loading.	10 Lectures
Unit V	Design of helical and leaf springs: Applications and limitations, Material selection and design calculations for sufficing strength requirements.	10 Lectures
Books:		
<ol style="list-style-type: none"> 1. Bhandari, V. B., Design of Machine Elements, Tata McGraw Hill, 2nd Ed., 2007. 2. Spotts, M.F., Shoup, T.E., Hornberger, L.E. Jayram, S.R., and Venkatesh, C.V., Design of Machine Elements, Person Education, 8th Edition., 2006. 3. Grover, O. P., Maleev and Hartman's Machine Design, 5th Edition, CBS Publishers New Delhi, 2011. 4. Juvinal, R.C., Marshek, K.M., Fundamentals of Machine Component Design, Wiley, 3rd Ed., 2007. 		

ME13102	Thermal Engineering: 4 Credits (3-0-2)	
Unit I	Fundamentals of Thermodynamics: Concepts of pure substance, types of systems, properties of systems, Extensive and Intensive properties with units and conversion like P, V, And temperature. Point function and path function. Work and Energy, Thermodynamic definition of work, heat, difference between heat and work, P.E., K.E, Internal Energy, Flow work, concepts of enthalpy, entropy. Laws of Thermodynamic Zeroth Law, Temperature measurement, principle of energy conservation, irreversibility, Second Law of Thermodynamics, Kelvin Plank, Clausius statements and their equivalence, Concept of perpetual motion machine 1 and Application of Thermodynamic laws - Steady Flow Energy equation and its application to open system like boiler, engine, nozzle, turbine, compressor & condenser. Application of Second law to Heat Engine, Heat Pump and Refrigerator.	10 Lectures
Unit II	Ideal Gases: Concept of Ideal gas, Charle's law, Boyle's law, Avogadro's law, equation of state, Characteristic gas constant and universal gas constant. Ideal gas processes: Isobaric, Isochoric, Isothermal, Adiabatic, Polytropic, Isentropic with representation of the processes on P-V and T-S diagram (only simple numericals)	06 Lectures
Unit III	Steam and Steam Boiler: Generation of steam at constant pressure with representation on various charts such as P-V, T-S, H-S, P-H. Properties of steam and use of steam table, Quality of steam and its determination with Separating, throttling and combined Separating and throttling calorimeter (no numerical). Vapour process: constant pressure, constant volume, constant enthalpy, constant entropy (numerical using steam table and Mollier chart), Rankine Cycle Steam Boilers: Classification of boilers. Construction and working of Cochran, Babcock and Wilcox, La- mont and Loeffler boiler. Boiler draught natural and Mechanical. Boiler mounting and accessories	10 Lectures
Unit IV	Steam Turbines and Condensers: Steam nozzle: Continuity equation, types of nozzles, concept of Mach number, critical pressure, application of steam nozzles. Steam turbine: Classification of turbines, Construction and working of Impulse and Reaction turbine, Compounding of turbines, Regenerative feed heating, bleeding of steam, nozzle control governing (no velocity diagrams and numerical). Steam condenser: Dalton's law of partial pressure, function and classification of condensers, construction and working of surface condensers; Sources of air leakage, concept of condenser efficiency, vacuum efficiency (no numerical); Cooling Towers: Force draught, natural draught and induced draught.	10 Lectures
Unit V	Heat Transfer: Modes of heat transfer: Conduction, convection and radiation. Conduction by heat transfer, Fourier's law, thermal conductivity, conduction through cylinder, thermal resistance, composite walls, combined conduction and	06 Lectures

	convection (Simple numerical); Heat transfer by Radiation: Thermal Radiation, Absorptivity, Transmissivity, Reflectivity, Emissivity, black and gray bodies, Stefan-Boltzman law; Heat Exchangers: Shell and tube, plate type, multiphase heat exchangers. Materials Used and applications of heat exchangers.	
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Books:

1. Domkundwar, V. M., A Course in Thermal Engineering, Dhanpat Rai & Co, 2014.
2. Ballaney, P. L., A Course in Thermal Engineering, Khanna Publishers, 1966.
3. Khurmi, R. S., A Text Book of Thermal Engineering, S. Chand & co. Ltd., 1978.
4. Rajput, R. K., A Course in Thermal Engineering, Laxmi Publication, Delhi, 2015.
5. Patel and Karmchandani, Heat Engine Vol. - I & II, Acharya Publication, 1966.
6. Nag, P. K., Engineering Thermodynamics, Tata McGraw Hill, 2008.
7. Sarkar, B. K., Thermal Engineering, Tata McGraw Hill, 2004.

ME13103 Measurement and Metrology: 3 Credits (2-0-2)

Unit I	Introduction to measurements: Definition of measurement; Significance of measurement; Methods of measurements; Classification of errors, Systematic and Random error. Terms applicable to measuring instruments: Precision and Accuracy, Sensitivity and Repeatability, Range, Threshold, Hysteresis, calibration; Error correction. Measuring instruments: Thread measurements: Thread gauge micrometer; Angle measurements Gauges: plain plug gauge, ring Gauge, snap gauge, limit gauge; Comparators: Characteristics of comparators.	06 Lectures
Unit II	Measurement of force, pressure, torque: Introduction; Force measurement: Spring Balance, Instrument used to measure flow, temperature, velocity and pressure. Direct Factors influencing selection of measuring instruments;	05 Lectures
Unit III	Applied mechanical measurements: Speed measurement, Humidity measurement, hair hygrometer; Density measurement: hydrometer; Liquid level measurement: sight glass.	06 Lectures
Unit IV	Material properties for metals and non metals. Behaviour of linear spring, rotating masses and various mechanism.	05 Lectures
Unit V	Direct & Indirect generalized measuring system; Standards of measurements: Primary & Secondary; Factors influencing selection of measuring instruments; Terms applicable to measuring instruments:	06 Lectures

Books:

1. Marangoni, Beckwith and Lienhard, Mechanical Measurements, Pearson Education, 6th Ed., 2006.
2. Bewoor, Anand K. and Kulakarni, V., Metrology & Measurements –, Tata McGraw Hill, New Delhi, 2009.
3. Alavala, Channakesava. R., Principles of Industrial Instrumentation and Control Systems, DELMAR Cenage learning, 2009.
4. Rajendra, R., Principles of Engineering Metrology, Jaico Publishers, 2008.
5. Dotson, C., Dimensional Metrology, DELMAR, Cenage learning, 2007.
6. Nakara, B.C. and Chaudhry, K.K., Instrumentation Measurement and Analysis, Tata McGraw Hill, 2nd Ed., 2005.
7. Jain, R.K., Engineering Metrology, Khanna Publishers, New Delhi, 2005.

ME13201 Fluid Mechanics and Machines: 5 Credits (3-1-2)

Unit I	Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications.	09 Lectures
Unit II	Exact flow solutions in channels and ducts, Couette and Poiseuille flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram.	09 Lectures
Unit III	Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis.	08 Lectures

Unit IV	Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle.	08 Lectures
Unit V	Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles– draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines.	08 Lectures
Books:		
<ol style="list-style-type: none"> 1. Massey, V., Thornes, Y. Nelson, Mechanics of fluids, Pearson, 2001. 2. Rajput, R.K., Fluid Mechanics & Hydraulic Machines, S. Chand Publishers, 1998. 3. Douglas, J.F., Gasiorek, J.M., Swaffield, J. A. and Jack, L.B., Fluid Mechanics, Pearson Education, 2008. 4. Som, S.K. and Biswas, G., Fluid Mechanics and Fluid Machines, McGraw Hill Education, 3rd Edition, 2012. 5. Dixon, S. L., Fluid Mechanics and Thermodynamics of Turbomachinery, Elsevier, 5th Ed, 1998. 6. Lal, Jagdish, Fluid Mechanics and Hydraulics, Metropolitan New Delhi, 9th Ed, 1991. 		

ME13202	Theory of Machines: 4 Credits (3-0-2)	
Unit I	Introduction: purpose, kinematics and kinetics, machines, structures, mechanisms and their inversions, elements of kinematic chain, kinematics fundamental, degree of freedom and its determination, lower pairs and higher pairs, types of motions, links, joints and kinematics chains, Grasshoff's law.	06 Lectures
Unit II	Velocity analysis: Graphical solution of velocity and acceleration of rigid mechanisms, velocity analysis with instantaneous centres. Acceleration analysis: graphical and analytical solution of acceleration of four bar linkages, slider crank mechanism, quick return mechanisms, Coriolis components.	12 Lectures
Unit III	Balancing of rotating masses. Gear trains.	08 Lectures
Unit IV	Gyroscope and governors	08 Lectures
Unit V	Cam dynamics: Analysis and design of cams and followers, jump phenomenon.	08 Lectures
Books:		
<ol style="list-style-type: none"> 1. Rattan, S.S., Theory of Machines, Tata McGraw Hill, 4th Edition, 2014. 2. Norton, R.L., Design of Machinery, Tata McGraw Hill, 4th Edition, 2008. 3. Shigley, J.E., Theory of Machines & Mechanism, McGraw Hill, 3rd Edition, 2009. 4. Beven, T., Theory of Machines, CBS Publications, 3rd Edition, 2005. 5. Ghosh, A. and Mallik, A.K., Theory of Mechanisms and Machines, Affiliated East West Press. 3rd Edition, 2008. 		

ME13001	Automobile Engineering: 3 Credits (3-0-0)	
Unit I	Introduction of Automobile: Classification of automobiles. Vehicle layout & types. Body construction - Types & Nomenclature of car body. Introduction to aerodynamic body shapes. Automobile market in India of "on road vehicles", major manufacturers, their products & their collaborations. Fuel supply system: Fuel feed system in S.I engine, types, gravity & pump feed system, layout of S.I engine fuel pump system, function of each component. Fuel mixing & circuit control system, carburetor, types, working principle of simple carburetor, requirement of air- fuel ratio, defects of carburetor & its remedy Circuits of carburetor, float, starting, idling, low speed, high speed & accelerating circuit Petrol injection system, types, layout & working principle of multi point fuel injection system, advantages & disadvantages. Fuel supply system in C.I engine, layout, components, function, types, working & line diagram of common rail, individual pump system, fuel injectors, single orifice, multiple orifices.	10 Lectures
Unit II	Automobile Transmission: Clutch- necessity, construction & working of coil spring & diaphragm spring type clutch. Gear Box- tractive effort and tractive resistance, types of G.B construction & working of constant mesh G.B., & synchromesh G.B., Epicyclic G.B., Torque converter, Overdrive, Transfer case. Final drive- necessity, construction & working of propeller shaft & differential. Axle- Type of rear axles, front axles & their applications.	08 Lectures

Unit III	Control Systems: Steering system- Requirement of steering system. Construction and working of steering linkage. Steering gear box- construction & working of rack and pinion & re-circulating ball type gearbox. Introduction to Power steering, Steering geometry- camber, caster, toe-in, toe-out, Kingpin inclination & their effects. Brake system- construction & working of hydraulic & Pneumatic brakes. Comparison of disc & drum brake.	08 Lectures
Unit IV	Suspension systems, wheels & Tyres: Necessity & classification of suspension system. Working & construction of Leaf spring, rigid axle suspension. Introduction to air suspension. Construction & working of McPherson & wishbone, trailing link suspensions. Construction & working of telescopic shock absorbers. Construction & working of spoked wheel, disc wheel & light alloy cast wheel. Types of rims, their construction & working. Construction, working & comparison of radial, cross-ply and tubed, tubeless tyre & tyre specifications. Factors affecting tyre life. Wheel Alignment and Balancing.	08 Lectures
Unit V	Automobile Electrical Systems & Body: Battery- working, construction & rating of battery. Ignition system- construction & working of electronic and CDI ignition system. Starting system- construction & working of starting motor. Charging system- construction & working of alternator. Wiring system-harnessing & colour codes. Lighting system-head light, tail light, indicator light & their circuits. Gauges- construction & working of Fuel level gauge, oil gauge and water temperature gauge. Use of microprocessor in automobile control systems.	08 Lectures
Books: <ol style="list-style-type: none"> 1. Jain, K. K. and Asthana, R.B., Automobile Engineering, Tata McGraw hill, 2002. 2. Sethi, H.M., Automotive Technology, Tata McGraw Hill,1991. 3. Narang, G.B.S., Automobile Engineering, Khanna Publication, 1995. 4. Glenn, Harold T., Auto Mechanics, Bennett and Mckknight, 1976. 5. Singh, Kirpal, Automobile Engineering Vol. I and Vol. II, Standard Publication, 2014. 6. Gupta, S.K., A text book in Automobile Engineering, S. Chand & co, 2014. 7. Singal, R.K., Automobile Engineering, S.K. Kataria& Sons, 2017. 		

ME13002	Mechatronics: 3 Credits (3-0-0)	
Unit I	<p>Concept of Mechatronics, Constituents of Mechatronics System, Application of Mechatronics in manufacturing, Introduction to Sensors & transducers, Principle of working and applications of Limit switches, proximity switches like inductive, capacitive and optical (deflecting and through beam type), Thumbwheel switches, magnetic reed switches, Optical encoders displacement measurement, rotary, incremental.</p> <p>Pneumatic, Hydraulic & Electrical Actuation System: Actuator – solenoids –on-off applications, latching, triggering,Types of relays- solid state, types of motors – DC motors, DC brushless motors, AC motors, stepper motors, servo motors</p>	08 Lectures
Unit II	<p>Computing Elements in Mechatronics: 8085 Microprocessor - Architecture, Pin configuration, working of microprocessor, and applications. Introduction to ICs used for interfacing such as – Programmable peripheral devices, USART, memory, keyboard, display LCD,LED,I/O device, ADC, DAC.</p> <p>8051 Microcontroller - Architecture, Pin configuration, working of microcontroller, Applications. Comparison of microprocessor and microcontroller, advantages and disadvantages.</p>	08 Lectures
Unit III	<p>Programmable Logic Controller - Introduction, PLC definition, PLC block diagram, Difference between relay panel and PLC, power supply, input/output modules (analog, digital) concepts of sink/source, set/reset, latch/unlatch, advantages and disadvantages. Installation, troubleshooting and maintenance of PLC.</p> <p>PLC Programming – Ladder diagrams and sequence listing, large process ladder diagram construction, flowcharting as a programming method, Basic PLC functions.</p>	08 Lectures
Unit IV	Register basics, timer functions, counter functions. Intermediate functions – Arithmetic functions, number comparison and number conversion functions. Data handling functions- SKIP, Master control relay, Jump, Move, Block move, Table to	10 Lectures

	register and register to table move functions. FIFO and LIFO functions, File Arithmetic and Logic function.	
Unit V	PLC digital bit functions and applications. Sequencer functions and cascading of sequencers. PLC matrix functions. Discrete and analog operation of PLC, Networking of PLCs. PLC auxiliary commands and functions. Online, offline, stop/run modes of operations, uploading/downloading between PLC and PC, Introduction to SCADA and DCS.	08 Lectures
Books:		
<ol style="list-style-type: none"> 1. Bolton, W., Mechatronics- Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education Ltd, 2015. 2. Histan, B.H. and Alciatore, D.G., Introduction to Mechatronics and Measurement Systems, Tata McGraw Hill Publishing, 2007. 3. Webb, John W. and Reis, R., Programmable Logic Controllers, Prentice Hall of India, 2002. 4. NIIT Programmable Logic Control – Principles and Applications Prentice Hall of India, 2004. 5. Mitra & Sengupta, Programmable Logic Controller & Industrial Automation, Penram International Publishing, 2017. 6. Kolk, R.A. and Shetty D., Mechatronics Systems Design, Vikas Publishing, New Delhi, 2010. 7. Mahalik N.P, Mechatronics Principles, Concepts and Applications, Tata McGraw Hill Publishing, 2004. 		

ME13003	Tool Engineering: 3 Credits (3-0-0)	
Unit I	Metal Cutting: Mechanics of Metal cutting; requirements of tools; cutting forces; types of chips; chip thickness ratio; shear angle; simple numericals only; types of metal cutting process; orthogonal; oblique and form cutting; Cutting fluids: types; characteristics and applications. Tool wear: Types of wear; Tool life; Tool life equations.	08 Lectures
Unit II	Machinability: definition; factors affecting machinability; machinability index. Tool materials: Types; characteristics; applications; Heat treatment of tool steels; Specification of carbide tips; Types of ceramic coatings. Cutting Tool Geometry: Single point cutting tool; drills; reamers; milling; cutters.	08 Lectures
Unit III	Types of dies and construction: Simple Die; Compound Die; Progressive Die; Combination Die. Punch & Die mountings: pilots; strippers; misfeed detectors; Pressure Pads; Knock outs; stock guide; Feed-Stop; guide bush; guide pins.	08 Lectures
Unit IV	Die Design Fundamentals: Die Operations; blanking; piercing; shearing; cropping; notching; lancing; coining; embossing; stamping; curling; drawing; bending; forming; Die set; Die shoe; Die area; Calculation of clearances on die and punch for blanking and piercing dies; Strip layout; Calculation of material utilization factor.	08 Lectures
Unit V	Forming Dies: Bending methods; Bending Dies; bend allowance; spring back; spanning; bending pressure; pressure pads; development of blank length. Drawing: operations; Metal flow during drawing; Calculation of Drawing blank size; variables affecting metal flow during drawing; single action and double action dies; combination dies. Fundamentals of other Tools: Constructional features of - Pressure Die casting dies; metal extrusion dies; injection molding dies; forging dies; plastic extrusion dies.	10 Lectures
Books:		
<ol style="list-style-type: none"> 1. Anglin, D., Tool Design -, Tata McGraw Hill, 2017. 2. H.M.T., Production Technology, Tata McGraw Hill, 2008. 3. Sharma, P.C., A Text Book of Production Engineering, S.Chand & Co., 2009. 4. Jain, R.K., Production Technology, Khanna Publishers, 2001. 		

ME13004	Advanced Manufacturing Processes: 3 Credits (3-0-0)	
Unit I	Introduction of conventional and nontraditional machining (NTM), classification of NTM and need for NTM. EDM and ECM: Working principle, material removal mechanism, process parameters, characteristics and application.	10 Lectures
Unit II	AJM: Mechanism of material removal and working principle, process parameters,	08 Lectures

	machining characteristics, effect of process parameters on material removal rate (MRR), applications and limitations. USM: mechanism of material removal, process parameters, machining characteristics, effect of process parameters on material removal rate (MRR), applications and limitations	
Unit III	LBM and EBM: Basic mechanism of material removal, process parameters, applications and limitations.	08 Lectures
Unit IV	Water jet machining, elevated temperature machining and cold temperature machining: material removal mechanism, applications and limitations.	08 Lectures
Unit V	Basic mechanism of material removal and applications of chemical milling, chemical blanking, chemical engraving, electroforming.	08 Lectures
Books:		
<ol style="list-style-type: none"> 1. Jain, V. K., Advanced Machining Processes, Allied Publishers, 2009. 2. Pandey, P. C., Modern Machining processes, Tata McGraw Hill Education, 2013. 3. Bhattacharya, A., A New Technology, The Institution of Engineers, India 1984. 4. Mishra, P.K., Nonconventional Machining, Narosa Publishing House, 1997 5. Ghosh, A. & Mallik, A.K., Manufacturing Science, East-West Press Pvt.Ltd, 2nd Ed., 2010. 		

ME13005	Industrial Engineering and Management: 3 Credits (3-0-0)	
Unit I	Plant Engineering: Plant; Selection of site of industry; Plant layout; Principles of a good layout; Types; Process; Product and Fixed position; Techniques to improve Layout; Principles of Material handling equipment; Plant maintenance; Importance; Break down maintenance; Preventive maintenance and Scheduled maintenance. Plant Safety: Importance; Accident: Causes and Cost of an Accident, Accident Proneness, Prevention of Accidents; Industrial disputes; Settlement of Industrial disputes; Collective bargaining; Conciliation; Mediation; Arbitration; Indian Factories Act 1948 and its provisions related to health, welfare and safety.	08 Lectures
Unit II	Work Study: Productivity; Standard of living; Method of improving Productivity; Objectives; Importance of good working conditions. Method Study: Definition; Objectives; Selection of a job for method study; Basic procedure for conduct of Method study; Tools used; Operation process chart; Flow process chart; Two handed process chart; Man Machine chart; String diagram and flow diagram. Work Measurement: Definition; Basic procedure in making a time study; Employees rating factor; Application of time allowances: Rest, Personal, Process, Special and Policy allowances; Calculation of standard time; Numerical Problems; Basic concept of production study; Techniques of Work Measurement; Ratio delay study; Synthesis from standard data; Analytical estimating and Pre determined Motion Time System (PMTS).	09 Lectures
Unit III	Introduction; Major functions of Production Planning and Control; Pre planning; Methods of forecasting; Routing and Scheduling; Dispatching and Controlling; Concept of Critical Path Method (CPM); Types of Production: Mass Production, Batch Production and Job Order Production; Characteristics; Economic Batch Quantity (EBQ); Principles of Product and Process Planning; Make or Buy decision; Numerical problems. Quality Control: Definition; Objectives; Types of Inspection: First piece, Floor and Centralized Inspection; Advantages and Disadvantages; Statistical Quality Control; Types of Measurements; Method of Variables; Method of Attributes; Uses of X, R, p and c charts; Operating Characteristics curve (O.C curve); Sampling Inspection; Single and Double Sampling plan; Concept of ISO 9001:2008 Quality Management System Registration/Certification procedure; Benefits of ISO to the organization.	09 Lectures
Unit IV	Definition of Management; Administration; Organization; F.W. Taylor's and Henry Fayol's Principles of Management; Functions of Manager; Types of Organization: Line, Staff, Taylor's Pure functional types; Line and staff and committee type; Directing; Leadership; Styles of Leadership; Qualities of a good leader; Motivation; Positive and Negative Motivation; Modern Management Techniques; Just In Time; Total Quality Management (TQM); Quality circle; Zero defect	08 Lectures

	concept; 5S Concept; Management Information Systems. Personnel Management: Responsibility of Human Resource Management; Selection Procedure; Training of Workers; Apprentice Training; On the Job training and Vestibule School Training; Job Evaluation and Merit Rating; Objectives and Importance; Wages and Salary Administration; Components of Wages; Wage Fixation; Type of Wage Payment: Halsey's 50% Plan, Rowan's Plan and Emerson's efficiency plan; Numerical Problems.	
Unit V	Financial Management: Fixed and Working Capital; Resources of Capital; Shares Preference and Equity Shares; Debentures; Type of debentures; Public Deposits; Factory Costing: Direct Cost; Indirect Cost; Factory Overhead; Selling Price of a product; Profit; Numerical Problems; Depreciation; Causes; Methods: Straight line, sinking fund and percentage on Diminishing Value Method; Numerical Problems. Material Management: Objectives of good stock control system; ABC analysis of Inventory; Procurement and Consumption cycle; Minimum Stock, Lead Time, Reorder Level-Economic Order Quantity problems; Supply Chain.	08 Lectures
Books:		
<ol style="list-style-type: none"> 1. Sharma, S.C. and Banga, T.R., Industrial Engineering & Management, Khanna Book Publishing Co. (P) Ltd., 2017. 2. Khanna, O.P., Industrial Engineering and Management, Revised Edition, Dhanpat Rai Publications (P) Ltd., 2018. 3. Wehrich, H., Koontz, H., Management-A global perspective, 10th Edition, McGraw Hill International Edition 1994. 4. Massie, Joseph L., Essentials of Management, 4th Edition, Prentice-Hall of India, 2004. 5. Kapoor, P., Principles and Practices of Management, Khanna Publishing House, 2019. 		

ME13006	Heat Transfer: 3 Credits (3-0-0)	
Unit I	Conduction: Fourier law of heat conduction for isotropic material; Thermal conductivity; Derivation of the energy equation in three dimensions including transient effect; Nondimensional - thermal diffusivity and Fourier number; Types of boundary conditions (Dirchlet, Neumann, mixed type); One dimensional solution with and without heat generation; Analogy with electrical circuits.	08 Lectures
Unit II	Fins: rectangular and pin fins. Fin effectiveness and efficiency. Critical thickness of insulation. Lumped parameter approach and physical significance of time constant, Biot number, Validity of lumped parameter approach. Introduction to Heissler Chart.	09 Lectures
Unit III	Convection: Introduction, Newton's law of cooling; Momentum and energy equations in two dimensions; nondimensionalisation, importance of nondimensional quantities and their physical significance. Velocity and thermal boundary layer thickness by integral method. Analogies between momentum, heat and mass transfer. Natural convection, effect of coupling on the conservation equations	09 Lectures
Unit IV	Radiation: Physical mechanism of thermal radiation, laws of radiation, definition of black body, emissive power, intensity of radiation, emissivity, reflectivity, transmittivity, irradiation, radiosity. Radiation exchange between black bodies, concept of Gray-Diffuse Isotropic (GDI) surface. Radiation exchange between GDI surfaces by radiation network and radiosity matrix method. Radiation shielding.	08 Lectures
Unit V	Heat exchangers: Types of heat exchangers, parallel and counterflow types, Introduction to LMTD. Correction factors, fouling factor. NTU method for heat exchangers.	08 Lectures
Books:		
<ol style="list-style-type: none"> 1. Incropera, F.P. and Dewitt, D.P., Fundamentals of Heat and Mass Transfer, John Wiley & Sons, 7th ed., 2011. 2. Ozisik, M.N., Heat Transfer - A Basic Approach, McGrawhill, 1985. 3. Holman, J.P., Heat Transfer, McGrawhill, 8th Ed., 1997. 4. Gupta, V., Elements of Heat & Mass Transfer, New Age International, 2nd Ed., 1994. 		

ME13011 Production and Operations Management: 3 Credits (3-0-0)		
Unit I	Process Planning and Process Engineering: Process Planning: Introduction, Function, Pre-requisites and steps in process planning, Factors affecting process planning, Make or buy decision, plant capacity and machine capacity. Process Engineering: Preliminary Part Print Analysis: Introduction, Establishing the General Characteristics of work piece, determining the principal Process, Functional surfaces of the work piece, Nature of the work to be Performed, Finishing and identifying operations. Dimensional Analysis: Introduction, types of dimensions, measuring the Geometry of form, Baselines, Direction of specific dimensions. Tolerance Analysis: Causes of work piece variation, Terms used in work piece dimensions, Tolerance stacks. Work piece Control: Introduction, Equilibrium Theories, Concept of location, Geometric Control, Dimensional control, Mechanical control	10 Lectures
Unit II	Production Forecasting: Introduction of production forecasting, The strategic role of forecasting in supply chain, Time frame, Demand behavior, Forecasting methods- Qualitative and Quantitative, Forecast accuracy. Scheduling: Introduction, Objectives in scheduling, Loading, Sequencing, Monitoring, Advanced Planning and Scheduling Systems, Theory of Constraints, Employee scheduling	08 Lectures
Unit III	Break-Even Analysis: Introduction, Break-even analysis charts, Breakeven analysis for process, plant and equipment selection. Aggregate Operations Planning: Aggregate production planning, Adjusting capacity to meet the demand, Demand management, Hierarchical and collaborative planning, Aggregate planning for services.	08 Lectures
Unit IV	Assembly Line Balancing: Assembly lines, Assembly line balancing, Splitting tasks, Flexible and U-shaped line layouts, Mixed model line balancing, Current thoughts on assembly lines, Computerized assembly line balancing	08 Lectures
Unit V	Material Management: Introduction, Importance and objectives, Purchasing and Stores: policies and procedures, Vendor development, selection, analysis and rating.	08 Lectures

Books:

1. Aswathappa, K., and Bhat, K.S., Production and Operations Management –Himalaya Publishing House, 2014.
2. Kale, S., Production and Operations Management – McGraw Hill Educations (India) Private Limited, 2013.
3. Paneerselvam, R., Production and Operations Management –PHI Learning Private Limited, 2013.
4. Monk, J., Operations Management, TMH Publishers, 2004.
5. Buffa, E. S., Modern Production/ Operations Management, John Wiley Publishers, 2002.

ME13012 Computer Aided Design and Manufacturing: 3 Credits (3-0-0)		
Unit I	Fundamentals of CAD/CAM: Automation; Design process; Application of computers for design; Benefits of CAD; Computer configuration for CAD applications; Design workstation; Graphic terminal; CAD Software: Definition of system software and application software; CAD database and structure. Geometric Modeling: 3D-Wire frame modeling; Wire frame entities and their definitions; Interpolation and Approximation of curves; Concept of Parametric and Non-parametric representation of curves; Curve fitting techniques.	10 Lectures
Unit II	Surface Modeling: Algebraic and Geometric form; Parametric space of surface; Blending functions; Parametrization of surface patch; Subdividing; Cylindrical surface; Ruled surface; Surface of revolution; Spherical surface; Composite surface; Bezier surface; Solid Modelling: Definition of cell composition and spatial occupancy enumeration; Sweep representation; Constructive solid geometry; Boundary representations.	10 Lectures
Unit III	Numerical control; Elements of NC system; NC part programming; Methods of NC part programming; Manual part programming, Computer assisted part programming; Post processor; Computerized part program.	07 Lectures
Unit IV	Group Technology: Part families; Parts classification and coding; Production analysis; Machine cell design; Computer aided process planning: Retrieval type and Generative type; Machinability data systems; MRP and its Benefits.	07 Lectures

Unit V	Flexible manufacturing system: F.M.S equipment; Layouts; Analysis methods and benefits; Computer aided quality control; Automated inspection: Off-line, On-line, Contact, Non-contact; Coordinate measuring machines; Machine vision; CIM system and Benefits.	08 Lectures
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Books:

1. Rao, P.N., CAD/CAM Principles and Applications, Tata McGraw-Hill, 2008.
2. Groover M.P. & Zimmers Jr, Computer Aided Design and Manufacturing, Prentice Hall of India, 2008.
3. Radhakrishna, P., Subramanyan, S. & Raju, V., CAD/CAM/CIM, Wiley Eastern Ltd., 2004.

ME13013	Alternate Energy Sources and Management: 3 Credits (3-0-0)	
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Unit I	Introduction to Energy Sources: Introduction, Major sources of energy: Renewable and Non-renewable, Primary and secondary energy sources, Energy Scenario: Prospects of alternate energy sources; Need of Alternate energy sources. Energy scenario in various sectors and Indian economy, Need and importance of energy conservation and management, Concept of Payback period, Return on investment (ROI), Life cycle cost, Sankey diagrams, specific energy consumption.	08 Lectures
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Unit II	Solar Energy: Principle of conversion of solar energy into heat and electricity, Solar Radiation: Solar Radiations at earth's surface, Solar Radiation Geometry: Declination, hour angle, altitude angle, incident angle, zenith angle, solar azimuth angle, Applications of Solar energy: Construction and working of typical flat plate collector and solar concentrating collectors and their applications. Advantages and limitations - Space heating and cooling. - Photovoltaic electric conversion. - Solar distillation, Solar cooking and furnace. - Solar pumping and Green House, Agriculture and Industrial process heat. (no derivations and numericals).	08 Lectures
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Unit III	Wind Energy: Basic Principle of wind energy conversion, Power in wind, Available wind power formulation, Power coefficient, Maximum power, Main considerations in selecting a site for wind mills, Advantages and limitations of wind energy conversion, Classification of wind mills, Construction and working of horizontal and vertical axis wind mills, their comparison, Main applications of wind energy for power generation and pumping.	06 Lectures
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Unit IV	Energy from Biomass: Common species recommended for biomass, Methods for obtaining energy from biomass, Thermal classification of biomass a) Gasified, b) Fixed bed and fluidized, Application of gasifier, Biodiesel production and application, Agriculture waste as a biomass, Biomass digester, Comparison of Biomass with conventional fuels	08 Lectures
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Unit V	Energy Conservation Techniques: Distribution of energy consumption, Principles of energy conservation, Energy audit, Types of audits, Methods of energy conservation, Cogeneration and its application, Combined cycle system, Concept of energy management, Study of different energy management techniques like - Analysis of input - Reuse and recycling of waste - Energy education: Conservative technique and energy audit. Economic approach of Energy Conservation: Costing of utilities like steam, compressed air, electricity and water, Ways of improving boiler efficiency, Thermal insulation, Critical thickness of insulation, Waste heat recovery systems, their applications, criteria for installing unit, An introductory approach of energy conservation in compressed air, refrigeration, air conditioning, pumps and fans.	12 Lectures
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Books:

1. Khan, B.H., Non-conventional Energy Resources, Tata McGraw Hill, 2006.
2. Rai, G. D., Non-conventional Energy Sources, Khanna publication, 1988.
3. Sukhatme, S. P., Solar Energy, Tata McGraw Hill, 2008.
4. Garg, H.P., Solar Energy, Tata McGraw Hill, 2008.
5. Arora, S.C., Domkundwar, S., Power Plant Engineering, Dhanpat Rai & Co., 1984.
6. Henderson, P.H., India- The Energy Sector, Oxford University Press.
7. Turner, W. C., Energy Management Handbook, Wiley Press, 1982.

ME13014 Material Handling System: 3 Credits (3-0-0)		
Unit I	Introduction to Material Handling System. Main types of material handling equipments & their applications, types of loads to be handled, types of movements, methods of stacking, loading & unloading systems, principles of material handling systems. Hoisting Machinery & Equipments: Construction, working & maintenance of different types of hoists such as lever operated hoist, portable hand chain hoist, differential hoists, worm geared and spur geared hoists, electric & pneumatic hoists, jumper. Construction, working & maintenance of different types of cranes such as rotary cranes, trackless cranes, mobile cranes, bridge cranes, cable cranes, floating cranes & cranes traveling on guide rails. Construction, working & maintenance of elevating equipments such as stackers, industrial lifts, freight elevators, passenger lifts, and mast type's elevators, vertical skip hoist elevators.	10 Lectures
Unit II	Conveying Machinery: Construction, working & maintenance of traction type conveyors such as belt conveyors, chain conveyors, bucket elevators, escalators. Construction, working & maintenance of traction less type conveyors such as gravity type conveyors, vibrating & oscillating conveyors, screw conveyors, pneumatic & hydraulic conveyors, hoppers gates & feeders.	07 Lectures
Unit III	Surface Transportation Equipment: Construction, function, working of trackless equipment such as hand operated trucks, powered trucks, tractors, AGV- Automatic Guided vehicle, industrial Trailers. Construction, function, working of cross handling equipment such as winches, capstans, Turntables, Transfer tables, monorail conveyors.	07 Lectures
Unit IV	Components of material handling systems: Flexible hoisting appliances such as welded load chains, roller chains, hemp ropes, steel wire ropes, fastening methods of wire & chains, eye bolts, lifting tackles lifting & rigging practices. Load handling attachments. a) Various types of hooks-forged, triangular eye hooks, appliances for suspending hooks, b) Crane grab for unit & piece loads c) Electric lifting magnet, vacuum lifter. d) Grabbing attachment for loose materials e) Crane attachment for handling liquids / molten metals: Arresting gear & Brakes. a) Arresting gear – construction & working b) Construction & use of electromagnetic shoe brakes Thruster operated shoe brakes, control brakes.	08 Lectures
Unit V	Mechanism used in material handling equipment. Steady state motion, starting & stopping of motion in following mechanisms. Hoisting mechanism - Lifting Mechanism - Traveling Mechanism - Slewing Mechanism - Rope & chain operated Cross- Traverse Mechanism. Selection of material handling equipment Factors affecting choice of material handling equipment such as type of loads, hourly capacity of the unit, direction & length of travel, methods of stocking at initial, final & intermediate points, nature of production process involved, specific load conditions & economics of material handling system.	10 Lectures

Books:

1. Rundenko, N., Material Handling Equipment, Peace Publisher, Moscow, 1964.
2. Alexandrov, M. P., Material Handling Equipment, MIR Publisher, Moscow, 1981.
3. Oberman, Y. I., Material Handling, MIR Publisher, Moscow, 2010.
4. Chowdary, R. B. & Tagore, G. R. N., Plant Layout and Materials Handling, Khanna Publisher, Delhi, 2nd edition, 2016.
5. Allegri T. H., Material Handling (Principles & Practice), CBS Publisher, Delhi, 2004.
6. Apple J. M., Plant layout & Materials Handling, John Wiley Publishers, 1977.
7. Immer J. R., Material Handling, McGraw Hill, New York, 1953.

ME13015 Industrial Robotics and Automation: 3 Credits (3-0-0)		
Unit I	Fundamentals of Robotics: Introduction; Definition; Robot anatomy (parts) and its working; Robot Components: Manipulator, End effectors; Construction of links, Types of joints; Classification of robots; Cartesian, Cylindrical, Spherical, Scara, Vertical articulated; Structural Characteristics of robots; Mechanical rigidity; Effects of structure on control work envelope and work Volume; Robot work Volumes, comparison; Advantages and disadvantages of robots.	10 Lectures
Unit II	Robotic Drive System and Controller: Actuators; Hydraulic, Pneumatic and Electrical drives; Linear actuator; Rotary drives; AC servo motor; DC servo motors	09 Lectures

	and Stepper motors; Conversion between linear and rotary motion; Feedback devices; Potentiometers; Optical encoders; DC tachometers; Robot controller; Level of Controller; Open loop and Closed loop controller; Microprocessor based control system; Robot path control: Point to point, Continuous path control and Sensor based path control; Controller programming.	
Unit III	Sensors: Requirements of a sensor; Principles and Applications of the following types of sensors: Position sensors (Encoders, Resolvers, Piezo Electric); Range sensors (Triangulation Principle, Structured lighting approach); Proximity sensing; Force and torque sensing. Introduction to Machine Vision: Robot vision system (scanning and digitizing image data); Image processing and analysis; Cameras (Acquisition of images); Videocon camera (Working principle & construction); Applications of Robot vision system: Inspection, Identification, Navigation & serving.	09 Lectures
Unit IV	Robot kinematics and Robot Programming: Forward Kinematics; Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional); Deviations and Problems. Teach Pendant Programming; Lead through programming; Robot programming Languages; VAL Programming; Motion Commands; Sensor Commands; End effector commands; and Simple programs.	07 Lectures
Unit V	Automation: Basic elements of automated system, advanced automation functions, levels of automation. Industrial Applications: Application of robots in machining; welding; assembly and material handling.	07 Lectures
Books:		
<ol style="list-style-type: none"> 1. Saeed, B. Niku, Introduction to Robotics: Analysis, Systems, Applications , Pearson Education Inc. New Delhi 2006. 2. Groover, M.P., Industrial Robotics: Technology, Programming and Applications, Tata McGraw Hill Co, 2001. 3. Fu. K.S. Gonzalz. R.C and Lee, C.S.G, Robotics Control, Sensing, Vision and Intelligence, McGraw Hill Book Co, 1987. 4. Koren, Y., Robotics for Engineers – , McGraw Hill Book Co, 1992. 5. Hedge, G.S., A Text book on Industrial Robotics, Laxmi Publications Pvt. Ltd., 2008. 6. Deb, S.R. & Deb, S., Robotics Technology and Flexible Automation, Tata McGraw-Hill, 2010. 		

ME13041	Mechatronics: 3 Credits (3-0-0)	
Unit I	Concept of Mechatronics, Constituents of Mechatronics System, Application of Mechatronics in manufacturing, Introduction to Sensors & transducers, Principle of working and applications of Limit switches, proximity switches like inductive, capacitive and optical (deflecting and through beam type), Thumbwheel switches, magnetic reed switches, Optical encoders displacement measurement, rotary, incremental. Pneumatic, Hydraulic & Electrical Actuation System: Actuator – solenoids –on-off applications, latching, triggering,Types of relays- solid state, types of motors – DC motors, DC brushless motors, AC motors, stepper motors, servo motors	08 Lectures
Unit II	Computing Elements in Mechatronics: 8085 Microprocessor - Architecture, Pin configuration, working of microprocessor, and applications. Introduction to ICs used for interfacing such as – Programmable peripheral devices, USART, memory, keyboard, display LCD,LED,I/O device, ADC, DAC. 8051 Microcontroller - Architecture, Pin configuration, working of microcontroller, Applications. Comparison of microprocessor and microcontroller, advantages and disadvantages.	08 Lectures
Unit III	Programmable Logic Controller - Introduction, PLC definition, PLC block diagram, Difference between relay panel and PLC, power supply, input/output modules (analog, digital) concepts of sink/source, set/reset, latch/unlatch, advantages and disadvantages. Installation, troubleshooting and maintenance of PLC. PLC Programming – Ladder diagrams and sequence listing, large process ladder diagram construction, flowcharting as a programming method, Basic PLC functions.	08 Lectures
Unit IV	Register basics, timer functions, counter functions. Intermediate functions – Arithmetic functions, number comparison and number conversion functions. Data	10 Lectures

	handling functions- SKIP, Master control relay, Jump, Move, Block move, Table to register and register to table move functions. FIFO and LIFO functions, File Arithmetic and Logic function.	
Unit V	PLC digital bit functions and applications. Sequencer functions and cascading of sequencers. PLC matrix functions. Discrete and analog operation of PLC, Networking of PLCs. PLC auxiliary commands and functions. Online, offline, stop/run modes of operations, uploading/downloading between PLC and PC, Introduction to SCADA and DCS.	08 Lectures

Books:

1. Bolton, W., Mechatronics- Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education Ltd, 2015.
2. Histan, B.H. and Alciatore, D.G., Introduction to Mechatronics and Measurement Systems, Tata McGraw Hill Publishing, 2007.
3. Webb, John W. and Reis, R., Programmable Logic Controllers, Prentice Hall of India, 2002.
4. NIIT Programmable Logic Control – Principles and Applications Prentice Hall of India, 2004.
5. Mitra & Sengupta, Programmable Logic Controller & Industrial Automation, Penram International Publishing, 2017.
6. Kolk, R.A. and Shetty D., Mechatronics Systems Design, Vikas Publishing, New Delhi, 2010.
7. Mahalik N.P, Mechatronics Principles, Concepts and Applications, Tata McGraw Hill Publishing, 2004.

ME13042 Computer Aided Design and Manufacturing: 3 Credits (3-0-0)		
Unit I	Fundamentals of CAD/CAM: Automation; Design process; Application of computers for design; Benefits of CAD; Computer configuration for CAD applications; Design workstation; Graphic terminal; CAD Software: Definition of system software and application software; CAD database and structure. Geometric Modeling: 3D-Wire frame modeling; Wire frame entities and their definitions; Interpolation and Approximation of curves; Concept of Parametric and Non-parametric representation of curves; Curve fitting techniques.	10 Lectures
Unit II	Surface Modeling: Algebraic and Geometric form; Parametric space of surface; Blending functions; Parametrization of surface patch; Subdividing; Cylindrical surface; Ruled surface; Surface of revolution; Spherical surface; Composite surface; Bezier surface; Solid Modelling: Definition of cell composition and spatial occupancy enumeration; Sweep representation; Constructive solid geometry; Boundary representations.	10 Lectures
Unit III	Numerical control; Elements of NC system; NC part programming; Methods of NC part programming; Manual part programming, Computer assisted part programming; Post processor; Computerized part program.	07 Lectures
Unit IV	Group Technology: Part families; Parts classification and coding; Production analysis; Machine cell design; Computer aided process planning: Retrieval type and Generative type; Machinability data systems; MRP and its Benefits.	07 Lectures
Unit V	Flexible manufacturing system: F.M.S equipment; Layouts; Analysis methods and benefits; Computer aided quality control; Automated inspection: Off-line, On-line, Contact, Non-contact; Coordinate measuring machines; Machine vision; CIM system and Benefits.	08 Lectures
Books:		
<ol style="list-style-type: none"> 1. Rao, P.N., CAD/CAM Principles and Applications, Tata McGraw-Hill, 2008. 2. Groover M.P. & Zimmers Jr, Computer Aided Design and Manufacturing, Prentice Hall of India, 2008. 3. Radhakrishna, P., Subramanyan, S. & Raju, V., CAD/CAM/CIM, Wiley Eastern Ltd., 2004. 		

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Open Elective – II/III						
S. N.	Course Code	Course Title	L	T	P	Credit
3.	CS13041	Object Oriented Programming	2	0	2	03

ES12100	Basics of Computers and Programming: 3 Credits (2-0-2)					
Unit I	Introduction to computers, Various components of a computer and their functions. Hardware: definition and components of a computer hardware system, Software: definition and types, difference with hardware, Algorithms and Flowcharts. Computer evolution -present day computer and future generation computer.					4 lectures
Unit II	DOS commands: DOS directory structure, file system, file format in DOS, internal command, external command, copy commands, Path command, different types of DOS commands and their uses.					4 lectures
Unit III	Introduction to programming languages and their uses, Features of C, C-tokens, datatypes in C, types of variables, declarations, type casting and expression, Control flow branching & looping, array.					6 lectures
Unit IV	Functions in C - Pass by value, Pass by reference, string manipulation, pointers, structure, union, File handling in C. Special features of C.					10 lectures
Unit V	Introduction to various computer peripherals, accessories and their operations. Computer peripherals: FDD, HDD, CDROM, CD-R, CDRW, Joystick, sound card, modem, display and display adapter, mouse, keyboard, cabinet, UPS etc and their uses.					4 lectures
Books:						
<ol style="list-style-type: none"> Balaguruswamy, Programming in ANSI C, Tata McGraw Hill, New Delhi, 1997. Byron Gottfried, Programming with C, McGraw Hill International, New York, 1996. Kernighan B W & Ritchie Denison, The C Programming Language, 2nd Ed., Prentice Hall of India, New Delhi, 1990. 						

CS13041	Object Oriented Programming: 3Credits (2-0-2)					
Unit I	Overviews of C, Procedural Vs Object Oriented Programming (OOP), characteristics of OOP, Variables, constants, operators in C++, Functions: Function Prototyping, Call by reference, Call by Value, Return by Reference, Inline Function, Constant Arguments, Function Overloading					4 lectures
Unit II	Classes & Objects, Arrays within a Class, Memory Allocation for Objects, Static Data Members, Static Member Functions, Arrays of Objects, Object as Function Arguments, Friend Functions, friend classes, Returning Objects, Constant member functions, Pointer to members, Constructor :Parameterized Constructor, Multiple Constructor in a Class, Constructors with Default Arguments, Dynamic Initialization of Objects, Copy Constructor, Dynamic constructor, Destructor and its uses.					5 lectures
Unit III	Operator Overloading: Defining operator Overloading, Overloading Unary, binary Operators, Overloading Binary Operator Using Friends, Manipulating of String Using Operators; Type Conversion details; Inheritance: Single, Multilevel, Hierarchical, Multiple, Hybrid Inheritance, Virtual Base Classes, Abstract Classes, Constructor in Derived Classes, Nesting of Classes.					7 lectures
Unit IV	Pointers, Pointer to Object, This pointer, Pointer to Derived Class, Virtual Function, Pure Virtual Function, Polymorphism implementations. Working with files, Command Line Arguments.					7 lectures
Unit V	Templates; Exception handling; Introduction to standard library; Namespace.					5 lectures
Books:						
<ol style="list-style-type: none"> Objected Oriented Programming with C++, E. Balaguruswamy, 6th Edition, TMH, 2013. Mastering C++, R. Venugopal, Rajkumar, T. Ravishankar, 2nd Edition, McGraw Hill Education, 2013. C++ Primer, S. B. Lippman & J. Lajoie, 5th Edition, Addison Wesley, 2012. Object Oriented Programming using C++, R. Lafore, BPB Publications, 2004. 						

DEPARTMENT OF CHEMISTRY

CY11101 Chemistry – I: 4 Credits (3-0-2)		
Unit I	Structure of Atom: Bohr's model of hydrogen and hydrogen like atoms, atomic spectrum of hydrogen, energy of electron, de-Broglie's equation and uncertainty principle; concept of atomic orbitals(s, p and d-orbitals) and their shapes etc.; quantum numbers, Pauli's exclusion principle, Hund's rule and Aufbau principle. Electronic configuration of elements.	6 lectures
Unit II	Modern periodic table and periodic properties: Modern periodic law, main features of long form of periodic table, periodic properties: atomic and ionic radii, metallic character, ionization potential, electron affinity and electronegativity. General feature and characteristics of s, p, d and f-block elements.	6 lectures
Unit III	Chemical Bonding: Ionic and covalent bonds. Salient features of valence bond theory, formation of H ₂ - molecule through atomic overlap and P.E. Diagram, σ and π bonds, sp, sp ² and sp ³ hybridizations with reference to CH ₄ , BF ₃ , and BeCl ₂ molecules, VSEPR theory, hybridization and shapes of NH ₃ and H ₂ O Molecules, Hybridization and geometry of PCl ₅ , SF ₆ , C ₂ H ₄ and C ₂ H ₂ molecules, M.O. theory, salient features, M.O. diagram of H ₂ , He ₂ ⁺ , N ₂ and O ₂ and bond order, Hydrogen and metallic bonds.	9 lectures
Unit IV	Hydrocarbons and Haloalkanes: Classification of Organic compounds, IUPAC nomenclature of hydrocarbons and compounds containing functional groups, Isomerism, aromatic hydrocarbons, structure of benzene, preparation and properties of benzene. Preparation and properties of haloalkanes.	9 lectures
Unit V	Compounds with Functional Groups: General methods of preparation and properties: alcohol, phenol, ether, aldehydes, ketones, carboxylic acids, nitro compounds, amine and azo compounds.	12 lectures

Books:

1. Modern's a b c of Chemistry, (Vol-I&II), S.P.Jauhar and S.K. Malhotra, Modern Publishers, New Delhi.
2. Comprehensive Chemistry (for Class XI and Class XII), N.K.Verma & S.K. Khanna, Laxmi Publications(P) Ltd. New Delhi.
3. Pradeep's New Course Chemistry (for Class XI and Class XII), S.C.Kheterpal, P.N.Kapil, S.N.Dhawan and R.S. Nandwani, Pradeep Publications, Jalandhar.
4. Chemistry (for Class XI and Class XII), NCERT, New Delhi.
5. Chemistry (Part I and Part-II), P.R.Mishra, B.Bhushan and H.R Sharma, Arya Book Depot, New Delhi.
6. Principle of Physical Chemistry, B.R. Puri, L.R. Sharma, M.S. Pathania, 48th Edition, 2019, Vishal Publishing Co., Jalandhar.
7. Physical Chemistry, P.C. Rakshit, revised 7th Edn., 2014, Sarat Book House, Calcutta.

CY11201 Chemistry – II: 3 Credits (2-0-2)		
Unit 1	Gaseous state: Ideal gas equation, kinetic molecular theory of gases, deviation of real gases from ideal gas behaviour, van der Waal's equation, critical phenomena: P-V isotherms of CO ₂ , critical constants, continuity of state.	07 lectures
Unit 2	Chemical Equilibrium: Reversible reaction, law of mass action, its application to chemical equilibrium and heterogeneous equilibrium, Le-chatelier's principle and its application. Ionic equilibria in aqueous solutions. Ostwald's dilution law, solubility product and common ion effect, their applications in qualitative analysis. Concept of acids and bases, pH, buffer solution.	08 lectures
Unit 3	Redox reactions: Oxidation and reduction process, oxidation state, calculation of equivalent weights of oxidising and reducing agents, balancing of redox reactions using oxidation number change method and ion electron method.	04 lectures
Unit 4	Electrochemistry-I: Weak and strong electrolytes, molar conductance. Variation of conductance with dilution, Kohlrausch's law. Faraday's laws of electrolysis. Electrolysis of fused NaCl, aqueous NaCl.	04 lectures
Unit 5	Electrochemistry-II: Electrochemical cells (General principle and working), electrode potential and cell potential (EMF). Standard Hydrogen Electrode (SHE) and standard calomel electrode. Electrochemical series and its applications. Nernst equation for electrode potential and cell potential. Primary cells: Leclanche cell; Secondary cells: Lead acid storage cell; Fuel cells: H ₂ -O ₂ cell.	05 lectures

Books:

1. Modern's abc of Chemistry, (Vol-I&II), S. P. Jauhar and S. K. Malhotra, Modern Publishers, New Delhi.
2. Comprehensive Chemistry (for Class XI and Class XII), N. K. Verma & S. K. Khanna, Laxmi Publications (P) Ltd., New Delhi.
3. Pradeep's New Course Chemistry (for Class XI and Class XII), S. C. Kheterpal, P. N. Kapil, S. N. Dhawan and R. S. Nandwani, Pradeep Publications, Jalandhar.
4. Chemistry (for Class XI and Class XII), NCERT, New Delhi.
5. Principle of Physical Chemistry, B. R. Puri, L. R. Sharma, M. S. Pathania, 48th Edition, 2019, Vishal Publishing Co., Jalandhar.

DEPARTMENT OF MATHEMATICS

MA11101 MATHEMATICS – I: 4 Credits (3-1-0)		
Unit I	Trigonometric ratios of compound, multiple and sub-multiple angles, general solution of trigonometric equations, properties and solution of triangles, inverse circular functions.	08 Lectures
Unit II	Complex numbers, modulus and amplitude of complex numbers, cube roots of unity and their properties, De-Moivre's theorem.	08 Lectures
Unit III	Logarithms and its properties, partial fractions, arithmetic progression (A.P) and geometric progression (G.P), permutation and combination.	08 Lectures
Unit IV	Binomial theorem for positive integral index, general and middle terms, greatest term, Binomial theorem for any index, mathematical induction.	08 Lectures
Unit V	Real functions, limit, continuity and differentiability of real functions, algebra of derivatives, differentiation of parametric, exponential, logarithmic, hyperbolic, trigonometric and inverse trigonometric functions.	10 Lectures
Books: <ol style="list-style-type: none"> 1. Mathematics for Class-XI and Class-XII, R.D Sharma, Dhanpati Rai, New Delhi, 2019. 2. Plane Trigonometry, Part-I, S.L.Loney, S. Chand & Co. New Delhi, 1998. 3. A Text book on differential Calculus, Dr. K.C.Sinha, Students Friends Publisher Patna, 2017. 4. A Text book of Higher Algebra, Hall & Knight, S.Chand & Co. New Delhi, 1998. 5. Elementary Engineering Mathematics, B.S. Grewal, Khanna Publishers, 1999. 6. A Text book on differential Calculus (Revised Edition), Gorakh Prasad, Pothishala Private Limited, 2017. 		

MA11201 MATHEMATICS – II: 4 Credits (3-1-0)		
Unit I	Introduction to two-dimensional co-ordinate geometry, equation of a straight line, distance of a point from a line, angle between two lines, angle bisector between two lines, pair of straight lines.	08 Lectures
Unit II	Introduction to conic section, Circle, tangent and normal to a circle, parabola, ellipse and hyperbola.	06 Lectures
Unit III	Introduction to indefinite integration, integration by substitution, integration by parts, integration by partial fraction, integration of rational and irrational functions.	08 Lectures
Unit IV	Basic of successive differentiation, Leibnitz's theorem, Roll's theorem and Lagrange's Mean value theorem, L' Hospital rule, maxima and minima of a function of single variable.	11 Lectures
Unit V	Definite integral, properties of definite integral, evaluation of definite integral by using its properties, area of simple curves using definite integrals.	09 Lectures
Books: <ol style="list-style-type: none"> 1. Elements of Co-ordinate Geometry, S.L. Loney, S Chand & Co. New Delhi, 2000. 2. Differential Calculus, Shanti Narayan, S.Chand and Co. 2016. 3. Mathematics for Class-XI and Class-XII, R.D Sharma, Dhanpati Rai, New Delhi, 2019. 4. A Text Book of Engineering Mathematics, N.P. Bali and M. Goyal, Laxmi Publications, 2014. 5. A Text book on Integral Calculus(Revised Edition), Gorakh Prasad, Pothishala Private Limited, 2017. 		

MA12101 MATHEMATICS – III: 4 Credits (3-1-0)		
Unit I	Introduction to three-dimensional co-ordinate geometry, direction cosines and direction ratios, equation of a plane, angle between two planes, general and symmetrical form of a straight line. co-planarity, shortest distance of lines. Sphere and its equations.	08 Lectures
Unit II	Determinant of matrices of order two and three, minors and co-factors, Cramer's rule, matrix, types of matrices, operation on matrices, invertible matrices, rank of a matrix by elementary operation, solution of linear simultaneous equations by inverse matrix and elementary operations.	08 Lectures
Unit III	Vector algebra: dot and cross products, scalar triple product and vector triple product, and its applications.	06 Lectures

Unit IV	Basic concepts of differential Equations, formation of differential equations, solution of differential equation of first order first degree, general and particular solution of differential equation.	08 Lectures
Unit V	Measure of dispersion, range, quartile deviation, mean deviation, variance, coefficient of variation. moments, skewness and kurtosis, probability and its basic properties, conditional probability, independent events, Baye's theorem.	12 Lectures
Books: <ol style="list-style-type: none"> 1. Ordinary and Partial Differential Equations, M D Raisinghania, S Chand & Company, 2019. 2. A Text Book of Engineering Mathematics, N.P. Bali & M. Goyal, Laxmi Publications, 2014. 3. Mathematics for Class-XI and Class-XII, R.D Sharma, Dhanpati Rai, New Delhi,2019. 4. Calculus and Analytic Geometry, G.B. Thomas and R.L. Finey, Addison Wesley, 9th edition, 1996. 5. The Manga Guide to Statistics, S. Takahashi, No Starch Press, 2008. 6. Schaum's Outline of Vector Analysis, M.R. Spiegel, 2009. 7. A Course in ordinary differential equation, Second Edition, B. Rai, D.P.Choudhary,H.I. Freedman, Narosa Publication, 2019. 		

DEPARTMENT OF PHYSICS

PH11101	Physics – I: 4 Credits (3-0-2)	
Unit I	System of units, fundamental and derived units, dimensions and their applications, orders of magnitude, accuracy and errors in measurements, random and instrumental errors, significant figures and rounding off, use of graphs in experimental physics. Vectors and scalars, vectors in two and three dimensions, unit vectors, vector addition and multiplication, resolution of a vector in a plane, scalar and vector products. Projectile motion, uniform circular motion, concept of angular velocity and acceleration, torque, static and kinetic friction, laws of friction.	10 lectures
Unit II	Elastic collision in one and two dimensions, gravitational potential energy and its conversion to KE, spring constant, potential energy of spring, different forms of energy, conservation of energy, Variation of acceleration due to gravity of earth with altitude, gravitational PE near the surface of the earth, gravitational potential, orbital velocity, escape velocity.	8 lectures
Unit III	States of matter, elastic properties, Hooke's law, Young's modulus, Bulk modulus, Shear modulus, Poisson's ratio, Fluid pressure, Pascal's law, buoyancy, floatation, Archimedes principle, atmospheric pressure, surface energy and surface tension, angle of contact, capillary rise and determination of surface tension using capillary rise method, detergent and surface tension, viscosity. Terminal velocity, Poissuille's formula (derivation using dimensional analysis only, Stoke's law, streamline flow, Bernoulli's theorem.	12 lectures
Unit IV	Heat and temperature, zeroth law and first law of thermodynamics, conversion from one scale to other, transfer of heat: conduction, convection and radiation.	4 lectures
Unit V	Periodic motion, simple harmonic motion and its equation, oscillations due to spring, KE and PE in SHM, simple pendulum, derivation of its expression of time period, determination of 'g' using simple pendulum, physical concepts of free, damped and forced oscillations, resonance	8 lectures
Books: 1. Physics for Class XI, Vol. I. Part I & II, NCERT, New Delhi. 2. Physics for Class XI, N.K. Bajaj, Tata McGraw Hill, New Delhi. 3. Physics, R. Resnick, D. Halliday and K.S. Krane, John Wiley & Sons, NY. 4. Modern's ABC, Vol. I, S.K. Gupta, Modern Publishers, New Delhi.		

PH11201	Physics –II:4 Credits (3-0-2)	
Unit I	Charges and their conservation, Coulomb's law, concept of electric flux, electric field and potential due to a point charge, dipole, its field along axis and perpendicular to it, conductors and insulators, concept of torque, force and torque experienced by a dipole in uniform electric field, capacitance, parallel plate capacitor with air/dielectric medium between the plates, series and parallel combinations of capacitors, energy of capacitors.	10 lectures
Unit II	Electric current, Ohm's law, resistivity, temperature dependence of resistance, resistances in series and parallel, Kirchhoff's laws, Wheatstone bridge, principle of potentiometer, determination of internal resistance of a cell.	8 lectures
Unit III	Electric power, heating effects of current, Joule's law, thermoelectricity- Seebeck, Peltier and Thompson effects, Biot-Savart law (statement only), magnetic field due to a straight wire and circular loop, force on a moving charge in a uniform magnetic field, force on a current carrying conductor and torque on current loop in a magnetic field, forces between two parallel current carrying conductors, definition of ampere.	10 lectures
Unit IV	Natural and man-made magnets, properties of bar magnet, current loop as magnetic dipole, magnetic moment, torque on a magnetic dipole in a uniform magnetic field. Lines of force in a magnetic field, comparison of bar magnet and solenoid, electromagnets, permanent magnets, Induced emf, Faraday's law, electromagnetic induction, self and mutual inductance, alternating currents.	6 lectures

Unit V	Refraction and dispersion of light due to prism, determination of minimum deviation, angle of prism. Wave motion, speed of a wave, principle of superposition, reflection of waves, harmonic waves (qualitative treatment only), formation of standing waves (graphical treatment only), standing waves in strings and pipes, Doppler effect.	8 lectures
Books: <ol style="list-style-type: none"> 1. Physics for Class XII, Vol. II. Part I & II, NCERT, New Delhi. 2. Physics for Class XII, N.K. Bajaj, Tata McGraw Hill, New Delhi. 3. Physics, R. Resnick, D. Halliday and K.S. Krane, John Wiley & Sons, NY. 4. Modern's ABC, Vol. II, S.K Gupta, Modern Publishers, New Delhi. 		

DEPARTMENT OF HUMANITIES & SOCIAL SCIENCES

HS11101	Remedial English – I: 3 Credits (2-0-2)	
Unit I	Uses of Language, Vocabulary, Pronunciation, Usage, Use of Lexicon and Thesaurus.	5 Lectures
Unit II	Punctuation, Sentence Construction.	5 Lectures
Unit III	Story-I: Reading/Explanation & Story-II: Reading/Explanation.	7 Lectures
Unit IV	Paragraph/Essay writing/Comprehension.	6 Lectures
Unit V	Essay-I: Reading/Explanation.	5 Lectures
Books:		
<ol style="list-style-type: none"> 1. Wood, F.T. 2008. An Outline History of the English Language, Macmillan India Ltd. New Delhi. 2. New Horizons: an anthology of English Prose and Poetry - Oxford University Press, New Delhi. 3. Wood, F.T. 2008. A Remedial English Grammar for Foreign Students, Macmillan India Limited. New Delhi. 4. McCarthy, M. 2016. English vocabulary in Use: Use: Advanced, Cambridge University Press. Cambridge. 5. James, Neil. 2009. Writing at Work, Allen and Unwin. London. 		

HS11201	Remedial English – II: 3 Credits (2-0-2)	
Unit I	Vocabulary-Lexical, Semantic and Phonological approaches, Dictionary referencing skills.	5 Lectures
Unit II	Précis/Summary /Essay writing.	6 Lectures
Unit III	Essay: Reading/Explanation & Short Story: Reading/Explanation.	6 Lectures
Unit IV	Basic Writing Skills and Business Communication/Technical Correspondence.	5 Lectures
Unit V	Report Writing, CV and Résumé.	6 Lectures
Books:		
<ol style="list-style-type: none"> 1. McCarthy, M. 2016. English vocabulary in Use: Use: Advanced, Cambridge University Press. Cambridge. 2. Regional Institute of English, Bangalore. 2006. English for Engineers, Cambridge University Press/Foundation Books. New Delhi. 3. Barun, K. Mitra. 2006. Effective Technical Communication: A Guide for Scientist and Engineers. OUP. New Delhi. 4. Shaffer, Lawrence. 2000. Comprehension, Précis and Paragraph Writing. Sarup & Sons Publishers. New Delhi. 5. Simon, Howard. 2009. Writing your Resume, Dorling Kindersley. Delhi. 		

HS12201	Fundamentals of Entrepreneurship:3 Credits (3-0-0)	
Unit I	Definition, Importance and relevance of entrepreneurship. Entrepreneurial values and attitudes: Innovativeness, independence, risk-taking and analytical ability. Entrepreneurial motivation: achievement planning, personal efficacy, entrepreneurial goal setting. Characteristics of entrepreneurs. Types of entrepreneurs, Rural entrepreneurs, and women entrepreneurs.	8 Lectures
Unit II	Launching a Business Venture: Identification of investment opportunities, Project formulation, Project screening, market demand forecasting. Project Analysis; Technical, Financial Environmental and Managerial aspects.	9 Lectures
Unit III	Project Appraisal; Means of financing and working results estimation, Raw materials use, processing, manufacturing and designing.	8 Lectures
Unit IV	Percentage and Ratio, Costs, Revenue, profit and loss, Discounting, interest computation, depreciation, Pay-back period, Net Present Value calculation, Cost-benefit analysis, Break-even analysis.	9 Lectures
Unit V	Environment and society, problems of environmental degradation, Socio-economic environment, Political environment and their impact on generating self-employment schemes, Preservation of environment and improvement in the quality of life in rural economy.	8 Lectures

Books:

1. Project preparation, Evaluation & Implementation, P. Chandra, Tata McGraw Hill.
2. Entrepreneurship Development, B.S. Rathore & J.S. Saini, Wiley Eastern Pvt.
3. Agri-Business and Entrepreneurship, Rajgopal, Indian Books & Periodicals.
4. Entrepreneurship: Starting a New Business, Anderson, Allied Publishers Ltd.
5. Entrepreneurship Development, S. S. Khanka.

HS12277	Essence of Indian Traditional Knowledge: 0 Credits (2-0-0)	
Unit I	Basic Structure of Indian Knowledge System.	5 Lectures
Unit II	Modern Science and Indian Knowledge System.	6 Lectures
Unit III	Yoga and Holistic Health care.	6 Lectures
Unit IV	Case Studies.	6 Lectures
Unit V	Case Studies.	5 Lectures

Books:

1. Cultural Heritage of India-Course Material, V. Sivaramakrishna Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014.
2. Modern Physics and Vedant Swami Jitatanand Bharatiya Vidya Bhavan.
3. The wave of Life Fritzof Capra.
4. Tao of Physics Fritzof Capra.
5. Tarkasangraha of Annam Bhatta, International V N Jha Chinmay Foundation, Velliarnad, Ernakulam,
6. Science of Consciousness, Psychotherapy and Yoga Practices, RN Jha VidyanidhiPrakasham, Delhi, 2016.

HS13277	Indian Constitution: 0 Credits (2-0-0)	
Unit I	The Constitution – Introduction; The History of the Making of the Indian Constitution; Preamble and the Basic Structure, and its interpretation; Fundamental Rights and Duties and their interpretation; • State Policy Principles.	5 Lectures
Unit II	Union Government; Structure of the Indian Union; President – Role and Power; Prime Minister and Council of Ministers; Lok Sabha and Rajya Sabha.	6 Lectures
Unit III	State Government; Governor – Role and Power; Chief Minister and Council of Ministers; State Secretariat.	6 Lectures
Unit IV	Local Administration; District Administration; Municipal Corporation; Zila Panchayat.	6 Lectures
Unit V	Election Commission; Role and Functioning; Chief Election Commissioner; State Election Commission.	5 Lectures

Books:

1. Ethics and Politics of the Indian Constitution, Rajeev Bhargava Oxford University Press, New Delhi, 2008
2. The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017).
3. Introduction to the Constitution of India, DD Basu Lexis Nexis; Twenty-Third 2018 edition.

Software/Learning Resources:

- a. <https://www.constitution.org/cons/india/const.html>
- b. <http://www.legislative.gov.in/constitution-of-india>
- c. <https://www.sci.gov.in/constitution>
- d. <https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/>