

## Third Year

### Semester - V

Sr. No.	Course Name	Course No.	Credit	L	P	T
1	<b>Machine Drawing and CAD/CAM Commuter Graphics</b>	<b>FMP - 301</b>	<b>3 (1 + 2)</b>	<b>1</b>	<b>2</b>	<b>0</b>

**Course content :**

First and third angle methods of projection. Preparation of working drawing from models and isometric views. Drawing of missing views. Different methods of dimensioning. Concept of sectioning. Revolved and oblique section. Sectional drawing of simple machine parts. Types of rivet heads and riveted joints. Processes for producing leak proof joints. Symbols for different types of welded joints. Nomenclature, thread profiles, multi-start threads, left and right hand thread. Square headed and hexagonal nuts and bolts. Conventional representation of threads. Different types of lock nuts, studs, machine screws, cap screws and wood screws. Foundation bolts. Design process, application of computers for design, definition of CAD, benefits of CAD, CAD system components. Computer hardware for CAD. Display, input and output devices. Graphic primitives, display file, frame buffer, display control, display processors, Line generation, graphics software. Points and lines, Polygons, filling of polygons. Text primitive. Other primitives. Windowing and clipping, view port. Homogeneous coordinates. Transformations. Planar and space curves design. Analytical and synthetic approaches. Parametric and implicit equations. B-spline and Beizer curves. Geometric modeling techniques. Wire frames. Introduction to solid modeling. Introduction to numerical control, basic components of NC system, NC coordinates and motion control systems. Computer numerical control, direct numerical control, combined CNC/DNC. NC machine tools and control units. Tooling for NC machines, part programming, punched tape, tape coding and format, manual and computer assisted part programming.

#### Planning of lectures

S.No	Proposed No. of Lectures	Proposed No. of Lectures
1.	1 <sup>st</sup> and 3 <sup>rd</sup> angle methods of projection	1
2.	Preparation of working drawings from models and isometric views	1
3.	Drawing of missing views and different methods of dimensioning	1
4.	Concept of sections, revolved and oblique sections	1
5.	Sectional drawing of simple machine parts	1
6.	Types of rivet heads and riveted joints, process of producing leak proof joints	1
7.	Threads nomenclature, profiles, mull start, left and right hand and conventional representation of threads	1
8.	Nuts and bolts- square headed, hexagonal, types of lock nuts, studs, machine screws, cap screw and wood screw, foundation bolts	1
9.	Application of computers for design CAD, define, benefits, system components and computer hardware for CAD, display, input and output devices	1
10.	Graphic primitives, display file, frame buffer, display control, display processors, line generation, graphics software. Points and lines, polygons, filing of polygons, text primitive, windowing and clipping, view port	1
11.	Homogeneous coordinates, transformations, planners and space curves	1

	design	
12.	Analytical and synthetic approaches, parametric and implicit equations	1
13.	B-spline and Biezer curves and Geometric modeling techniques, wire frames	1
14.	Introduction to solid modeling, introduction to numeric control, basic components of NC system, NC coordinate and motion control system	1
15.	Computer numerical control, direct numerical control, combined CNC /DNC	1
16.	NC machine tools and control units, tooling for NC machines, part programming, punched tape coding and format	1
17.	Manual and computer assisted programming	1
	<b>Total</b>	<b>17</b>
<b>Total</b>		
<b>Practicals</b>		
S.No.	Topic	No. of Practicals
1	Preparation of manual drawing with dimensions from models	2
2	Preparation of manual drawing with dimensions from isometric drawings	2
3	Preparation of manual drawing with dimensions from machine components	2
4	Preparations of sectional drawings of single machine parts	2
5	Preparations of drawing of riveted joints	1
6	Preparations of drawings of thread fasteners	2
7	Demonstration on computer graphics	2
8	Demonstration on computer aided drafting using standard software	2
9	Practice on the use of basic and drawing commands on Auto cad	5
10	Generating simple 2-0 drawings with dimensions using Auto cad	3
11	Practice in use of modify and rebelling commands	3
12	Practice in graphics	2
13	Practice in mathematics	2
14	Practice in curve fitting and transformation	2
15	Demonstration on CNC machine	2
	<b>Total</b>	<b>34</b>
<b>Reference Books</b>		
<ul style="list-style-type: none"> <li>• Quality in Design and Manufacturing (CAD/CAM) ,By: Dalela Suresh</li> <li>• Mechatronics – K. Adinarayana</li> <li>• CAD/CAM Robotics &amp; factories of the future ,By: S. Narayan, K. J. Reddy, P. Kuppan K.</li> <li>• CAD/CAM ,By: Rao P.N.</li> <li>• CAD/CAM : Computer-Aided Design And Manufacturing , By: Groover, M, Zimmers, E</li> <li>• CAD/CAM Theory And Practice, By: Zeid, Ibrahim</li> </ul>		

Sr. No.	Course Name	Course No.	Credit	L	P	T
2	Machine Design	FMP - 303	3 (2 + 1)	2	1	0
<b>Course content :</b>						
Meaning of design, Phases of design, design considerations. Common engineering materials and their mechanical properties. Types of loads and stresses, theories of failure, factor of safety, selection of allowable stress. Stress concentration. Elementary fatigue and creep aspects. Cotter joints, knuckle joint and pinned joints, turnbuckle. Design of welded subjected to static loads. Design of threaded fasteners subjected to direct static loads, bolted joints loaded in shear and bolted joints subjected to eccentric loading. Design of shafts under torsion and combined bending and torsion. Design of keys. Design of muff, sleeve, and rigid flange couplings. Design of helical and leaf springs. Design of flat belt and V-belt drives and pulleys. Design of gears. Design of brackets, levers, columns, thin cylindrical and spherical shells. Design of screw motion mechanisms like screw jack, lead screw, etc. Selection of antifriction bearings. Design of curved beams; Crane hooks, circular rings, etc.						
<b>Planning of lectures</b>						
S.No.	Topics to be covered in Lecture					Proposed No. of Lectures
1	Meaning of design, machine design, phase of design, design considerations					2
2	Common engineering materials and their mechanical properties					2
3	Types of loads and stresses, theories of failure, factor of safety, selection of allowable stress					2
4	Stress concentration, elementary fatigue and creep aspect					2
5	Design of cotter joints, knuckle joints, pin joint and turn buckle					3
6	Design of welded joints subjected to static loads					2
7	Design of threaded fasteners subjected to direct static loads, bolted joints loaded shear and eccentric loading					3
8	Design of shaft under torsion and combines bending and torsion					3
9	Design of keys, muff (sleeve), coupling and flange coupling					3
10	Design of helical and leaf spring, design of flat belt and V belt and pulley					3
11	Gear design, design of bracket, levers, columns, thin cylinder and shell					3
12	Design of jack screw, selection of anti friction bearing					2
13	Design of curve beams, crane hooks, circular rings					2
	<b>Total</b>					<b>32</b>
<b>Practicals</b>						
S.No.	Topic					No. of Practicals
1	Study of stress analysis of different machine components Viz. rectangular strut, circular and hollow circular column					2
2	Problem based on load and stress analysis of strut, column, C- clamp brackets etc.					2
3	Study of theories of failure and related problems					2
4	Problems based on practical application of theories of failure					1
5	Study of factor of safety in normal loading and cyclic loading.					2
6	Design and drawing of knuckle joint and cotter joint.					2
7	Design and drawing of lever rocker arm of diesel engine.					1
8	Design and drawing of muff coupling and flange coupling.					2
9	Design and drawing of Helical spring					1

	<b>Total</b>	<b>15</b>
<b>Reference Books</b>		
<ul style="list-style-type: none"> <li>• Machine Design, By: R.S. Khurmi &amp; Gupta</li> <li>• Machine Design , By: R.C. Patel</li> <li>• Machine Design , By: Agrawal P.S.</li> <li>• Machine Design , By: Gohel D.B.</li> <li>• Machine Design , By: Pandya &amp; Shah</li> </ul>		

Sr. No.	Course Name	Course No.	Credit	L	P	T
<b>3</b>	<b>Dairy and Food Engineering</b>	<b>PFE - 301</b>	<b>3 (2 + 1)</b>	<b>2</b>	<b>1</b>	<b>0</b>

**Course content :**

Dairy development in India. Engineering, thermal and chemical properties of milk and milk products, unit operation of various dairy and food processing systems, process flow charts for product manufacture, working principles of equipment for receiving, pasteurization sterilization, homogenisation, filling & packaging, butter manufacture, dairy plant design and layout, composition and proximate analysis of food products. Deterioration in products and their controls. Physical, chemical and biological methods of food preservation, changes undergone by the food components during processing, evaporation, drying, freezing juice extraction, filtration, membrane separation, thermal processing, plant utilities requirement.

**Planning of lectures**

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Dairy development in India.	1
2	Engineering, thermal and chemical properties of milk and milk products.	4
3	Unit operation of various dairy and food processing systems, process flow charts for product manufacture.	4
4	Working principles of equipment for receiving, pasteurization sterilization, homogenization, filling & packaging, butter manufacture.	7
5	Dairy plant design and layout, composition and proximate analysis of food products.	4
6	Deterioration in products and their controls.	3
7	Physical, chemical and biological methods of food preservation.	4
8	Changes undergone by the food components during processing, evaporation, drying, freezing juice extraction, filtration, membrane separation, thermal processing.	4
9	Plant utilities requirement.	3
<b>Total</b>		<b>34</b>

**Practicals**

S.No.	Topic	No. of Practicals
1	Study of a composite pilot milk processing plant & equipments	1
2	Study of pasteurizers	1
3	Study of sterilizers	1
4	Study of homogenisers	1
5	Study of separators	1
6	Study of butter churners	1

7	Study of evaporators	1
8	Study of milk dryers.	1
9	Study of freezers.	1
10	Design of food processing plants & preparation of layout.	1
11	Visit to multi-product dairy product.	1
12	Determination of physical properties of food products.	1
13	Estimation of steam requirements.	1
14	Estimation of refrigeration requirements in dairy & food plant	1
15	Visit to Food industry.	1
<b>Total</b>		<b>15</b>

#### Reference Books /

- Dairy plant engineering and management, By: Tufail Ahmed..
- Engineering for dairy and food products, By: Farrall, A. W..
- Food processing Technology: Principle and Practice, By: Fellow, P
- Introduction to Food Engineering, By: Singh, R.P. and Heldman, D.R.
- The Technology of milk processing, By: Khan A. Q. and Padmanabhan, P.N.
- Food Engineering Brennam, By: J. G., Butters J.R., Cowell N.D and Lilly, A.E.I.
- Food process engineering, By: Heldman, D. R and Singh, R.P. (1981).

Sr. No.	Course Name	Course No.	Credit	L	P	T
4	<b>Tractor Systems and Controls</b>	<b>FMP - 305</b>	<b>3 (2 + 1)</b>	<b>2</b>	<b>1</b>	<b>0</b>
<b>Course content :</b>						
Study of transmission systems, clutch, gear box, differential and final drive mechanism. Familiarization of brake mechanism. Ackerman steering and hydraulic systems. Tractor power outlets: P.T.O., belt pulley, drawbar, etc. Tractor chassis mechanics and design for tractor stability. Ergonomic considerations and operational safety.						
<b>Planning of lectures</b>						
S.No.	Topics to be covered in Lecture					Proposed No. of Lectures
1	Study of transmission systems, clutch, gear box, differential and final drive mechanism					6
2	Familiarization of brake mechanism					3
3	Ackerman and hydraulic steering and hydraulic systems					4
4	Tractor power outlets- PTO, belt pulley, drawbar etc.					3
5	Tractor chassis mechanics and design for tractor stability					5
6	Ergonomics consideration and operational safety					4
7	Revision and problems					5
<b>Total</b>					<b>30</b>	
<b>Practicals</b>						
S.No.	Topic					No. of Practicals
1	Introduction to transmission systems and components					1
2	Study of clutch functioning, parts and design problem on clutch system					1
3	Study of different types of gear box, calculations of speed ratios					1
4	Design problem on gear box					1

5	Study on differential and final drive and planetary gears	1
6	Study of brake systems and some design problems	1
7	Steering geometry and adjustments	1
8	Study of hydraulic systems in a tractor, hydraulic trailer and some design problems	2
9	Traction performance of a tractor wheel	1
10	Finding C.G. of a tractor by weighing technique	1
11	Finding C.G. of a tractor using suspension / balancing techniques	1
12	Finding moment of inertia of a tractor	1
13	Appraisal of various controls in different makes tractors in relation to anthropometric measurements	1
	<b>Total</b>	<b>14</b>

#### Reference Books

- Tractors & their power units , By: J.B. Liljedahl, P.K. Turnquist, D.W. Smith & M. Hoki
- Tractor , By: Oleg Sapunon
- Theory of machines , By: P.L. Ballaney
- Human factors in Engg, & Design , By: Mark S., Sanders & Ernet J. McCormick
- Automobile Engineering Vol. I , By: Kirpal Singh
- Tractors and their Power Units. , By: Barger E.L., Bainer & Liljedhal.
- Theory, Maintenance and Repair. , By: Gupta RB and Gupta BK. Tractor Mechanics.
- Testing and Evaluation of Agricultural Machinery. , By: Mehta ML, Verma SR, Mishra SK and Sharma VK. National Agricultural Technology Information Centre., Ludhiana.
- Farm Tractor – Maintenance and repair, By: Jain SC and Rai CR.
- Tractor and Auto mobiles. , By: Rodichev V and Rodicheva G.
- Principles and Practices. , By: Heitner J. Automotive Mechanics –
- Agricultural Engineers Hand Book , By: Richey C.W., Jacobson P. and Hall C.W.
- John Deere. Fundamentals of Service Hydraulics.
- Relevant Tractor Test Codes -I.S.E. OECD, etc.

Sr. No.	Course Name	Course No.	Credit	L	P	T
5	Electrical Machines and Power Utilization	PFE - 303	3 (2 + 1)	2	1	0

**Course content:**

Electro motive force, reluctance, laws of magnetic circuits, determination of ampere-turns for series and parallel magnetic circuits, hysteresis and eddy current losses, Transformer: principle of working, construction of single phase transformer, EMF equation, phasor diagram on load, leakage reactance, transformer on load, equivalent circuit, voltage regulation, power and energy efficiency, open circuit and short circuit tests, principles, operation and performance of DC machine (generator and motor), EMF and torque equations, armature reaction, commutation, excitation of DC generator and their characteristics, DC motor characteristics, starting of shunt and series motor, starters, speed control methods-field and armature control, polyphase induction motor: construction, operation, equivalent circuit, phasor diagram, effect of rotor resistance, torque equation, starting and speed control methods, single phase induction motor: double field revolving theory, equivalent circuit, characteristics, phase split, shaded pole motors, disadvantage of low power factor and power factor improvement, various methods of single and three phase power measurement.

**Planning of lectures**

S.No.	Topics to be covered in Lecture	Proposed No. of Lectures
1	Electro motive force, reluctance, laws of magnetic circuits, determination of ampere-turns for series and parallel magnetic circuits.	3
2	Hysteresis and eddy current losses.	2
3	Transformer: principle of working, construction of single phase transformer.	2
4	EMF equation, phase diagram on load, leakage reactance, transformer on load, equivalent circuit, voltage regulation.	3
5	Power and energy efficiency, open circuit and short circuit tests, principles.	2
6	Operation and performance of DC machine (generator and motor).	2
7	EMF and torque equations, armature reaction, commutation, excitation of DC generator and their characteristics.	3
8	DC motor characteristics, starting of shunt and series motor, starters, speed control methods-field and armature control.	3
9	Polyphase induction motor: construction, operation, equivalent circuit.	2
10	Phase diagram, effect of rotor resistance, torque equation, starting and speed control methods.	3
11	Single phase induction motor: double field revolving theory, equivalent circuit, characteristics.	3
12	Phase split, shaded pole motors.	2
13	Disadvantage of low power factor and power factor improvement.	2
14	Various methods of single and three phase power measurement.	2
<b>Total</b>		<b>34</b>

**Practicals**

S.No.	Topic	No. of Practicals
1	To get familiar with AC, DC machines and measuring instruments.	1
2	To perform Open circuit and short circuit tests on a single phase	2

	transformer and hence find equivalent circuit , voltage regulation and efficiency.	
3	To study the constructional details of D.C. machine and to draw sketches of different components.	1
4	To obtain load characteristics of d.c. shunt/series /compound generator.	2
5	To study characteristics of DC shunt/ series motors.	1
6	To study d.c. motor starters.	1
7	To Perform load-test on 3 ph. Induction motor & to plot torque V/S speed characteristics.	1
8	To Perform no-load & blocked –rotor tests on 3 ph. Induction motor to obtain equivalent ckt. Parameters & to draw circle diagram.	2
9	To study the speed control of 3 ph. Induction motor by cascading of two induction motors, i.e. by feeding the slip power of one motor into the other motor.	1
10	To study star- delta starters physically and to draw electrical connection diagram to start the 3 ph. Induction motor using it to reverse the direction of 3 ph. I.M.	1
11	To start a 3 phase slip –ring induction motor by inserting different levels of resistance in the rotor ckt. And to plot torque –speed characteristics.	1
12	To perform no-load & blocked –rotor test on 1 ph. Induction motor & to determine the parameters of equivalent ckt. Drawn on the basis of double revolving field theory.	1
13	To Perform load –test on 1 ph. Induction motor	1
	<b>Total</b>	<b>16</b>
<b>Reference Books</b>		
<ul style="list-style-type: none"> <li>• Principles of D.C. machines , By: Langsdorff</li> <li>• Electrical Machines , By: Nagrath &amp; Kothari</li> <li>• Electrical Machinery , By: P.S. Bhimbhra</li> <li>• A textbook of electrical technology, Vol II, By: B L Threja</li> <li>• A course in electrical technology , By: J B gupta</li> </ul>		

Sr. No.	Course Name	Course No.	Credit	L	P	T
6	<b>Field Operation and Maintenance of Tractors and Farm Machinery - II</b>	<b>FMP-307</b>	<b>2 (1 + 1)</b>	<b>1</b>	<b>1</b>	<b>0</b>
<b>Course content:</b>						
Introduction to tractor maintenance procedure and troubleshooting. Scheduled maintenance after 10,50,100,250,500 and 1000 hrs. of operation. Safety hints. Top end overhauling. Fuel saving tips. Preparing the tractor for storage. Care and maintenance procedure of agricultural machinery during operation and off-season. Repair and maintenance workshop requirements.						
<b>Planning of lectures</b>						
S.No.	Topics to be covered in Lecture					Proposed No. of Lectures
1	Introduction to tractor maintenance procedure					1
2	Trouble and trouble shooting					2



3	Scheduled maintenance 10,50, 100, 250, 500 and 1000 hrs	3
4	Safety hints	2
5	Top end overhauling	2
6	Fuel saving tips	1
7	Preparing the tractor for storage	1
8	Care and maintenance procedure of agril. Machinery during operation and off season	2
9	Maintenance of workshop and minor repair	2
	<b>Total</b>	<b>16</b>

<b>Practicals</b>		
S.No.	Topic	No. of Practical
1	Introduction to fuel system	1
2	Introduction to lubrication system	1
3	Introduction to Cooling system	1
4	Introduction to electrical system	1
5	Introduction to transmission system	1
6	Introduction to hydraulic system and final drive	1
7	Familiarization with tractor controls , starting stopping etc.	1
8	Driving of tractors (forward and reverse)	1
9	Hitching system, setting and field operation of farm machinery	2
10	Familiarization with different makes and models of tractors available	1
11	Hitching and operation of M.B. plough adjustment	1
12	Hitching and operation of trailing and mounted disc harrow	1
13	Field operation and adjustments of seed drills, planter, sprayers	3
	<b>Total</b>	<b>16</b>

**Reference Books**

- Repair & maintenance of tractors , By: Jain & Rai
- Farm Machines and equipment , By: CP Nakra, Dhanpar Rai & sons, New Delhi
- Operator's service manuals of each tractors, farm machinery.
- Farm machine , By: Jagdishwar Sahaye

Sr. No.	Course Name	Course No.	Credit	L	P	T
7	Strength of Material	RE - 301	3 (2 + 1)	2	1	0
<b>Course content :</b>						
Slope and deflection of beams using integration techniques, moment area theorems and conjugate beam method. Columns and Struts. Riveted and welded connections. Stability of masonry dams. Analysis of statically indeterminate beams. Propped beams. Fixed and continuous beam analysis using superposition, three moment equation and moment distribution methods.						
<b>Planning of lectures</b>						
S.No.	Topics to be covered in Lecture					Proposed No. of Lectures
1	Slope and deflection of beams using integration techniques					3
2	Moment area theorems and conjugate beam method					3
3	Columns and Struts					3

4	Riveted and welded connections.	4
5	Stability of masonry dams	5
6	Analysis of statically indeterminate beams	5
7	Propped beams	3
8	Fixed and continuous beam analysis using superposition	3
9	Three moment equation and moment distribution methods.	4
<b>Total</b>		<b>33</b>
<b>Practicals</b>		
S.No.	Topic	No. of Practical
1	To perform the tension test on metal specimen (M.S., C.I.), to observe the behaviour of materials under load, to calculate the value of E, ultimate stress, permissible stress, percentage elongation etc. and to study its fracture.	1
2	To perform the compression test on; Concrete cylinders & cubes, C.I., M.S. & Wood specimens and to determine various physical and mechanical properties.	1
3	To perform the bending test on the specimens; M.S. Girder, Wooden beam, Plain concrete beams & R.C.C. Beam, and to determine the various physical and mechanical properties	1
4	To determine Young's modulus of elasticity of beam with the help of deflection produced at centre due to loads placed at centre & quarter points	1
5	To study the behaviour of materials (G.I. pipes, M.S., C.I.) under torsion and to evaluate various elastic constants.	1
6	To study load deflection and other physical properties of closely coiled helical spring in tension and compression.	1
7	To perform the Rockwell, Vicker's and Brinell's Hardness tests on the given specimens.	1
8	To perform the Drop Hammer Test, Izod Test and Charpay's impact tests on the given specimens.	1
9	To determine compressive & tensile strength of cement after making cubes and briquettes.	3
10	To measure workability of concrete (slump test, compaction factor test)	2
11	To determine voids ratio & bulk density of cement, fine aggregates and coarse aggregates.	1
12	To determine fatigue strength of a given specimen.	1
13	To write detail report emphasizing engineering importance of performing tension, compression, bending, torsion, impact and hardness tests on the materials.	1
<b>Total</b>		<b>16</b>
<b>Reference Books</b>		
<ul style="list-style-type: none"> <li>• Mechanics of Materials , By: E. P. Popov</li> <li>• Strength of Material , By: Ramamrutham</li> <li>• Strength of Materials and Mechanics of Structures , By: B. C. Punmia,</li> <li>• Analysis of Structures Vol.-I and Vol.-II , By: V. N. Vazirani &amp; M. M. Ratwani</li> <li>• Theory of Structures , By: S. Ramamrutham and R. Narayan,</li> </ul>		

Sr. No.	Course Name	Course No.	Credit	L	P	T
8	Ground Water, Wells and Pumps	SWE - 301	3 (2 + 1)	2	1	0
<b>Course content :</b>						
<p>Occurrence and movement of ground water, aquifer and its types, classification of wells, steady and transient flow into partially, fully and non-penetrating and open wells, familiarization of various types of bore wells common in the state, design of open well, groundwater exploration techniques, methods of drilling of wells, percussion, rotary, reverse rotary, design of assembly and gravel pack, installation of well screen, completion and development of well, groundwater hydraulics-determination of aquifer parameters by different method such as Theis, Jacob and Chow' s etc. Theis recovery method, well interference, multiple well systems, surface and subsurface exploitation and estimation of ground water potential, quality of ground water, artificial groundwater recharge planning, modeling, ground water project formulation. Pumping Systems: Water lifting devices; different types of pumping machinery, classification of pumps, component parts of centrifugal pumps; pump selection, installation and trouble shooting; design of centrifugal pumps, performance curves, effect of speed on head capacity, power capacity and efficiency curves, effect of change of impeller dimensions on performance characteristics; hydraulic ram, propeller pumps, mixed flow pumps and their performance characteristics; priming, self priming devices, rotodynamic pumps for special purposes such as deep well turbine pump and submersible pump.</p>						
<b>Planning of lectures</b>						
S.No.	Topics to be covered in Lecture					Proposed No. of Lectures
1	Occurrence and movement of ground water, aquifer and its types, classification of wells, steady and transient flow into partially, fully and non penetrating and open wells, familiarization of various types of bore wells common in state, design of open well, ground water exploration techniques, methods of drilling of wells, percussion, rotary, reverse rotary, design of assembly and gravel pack, installation of well screen completion, and development of well					6
2	Ground water hydraulics, determination of aquifer parameters by different methods, such as Theis, Jacob, and Chow's etc. Theis recovery method, well interference, multiple well systems, surface and sub-surface exploitation, and estimation of ground water potential, quality of ground water, Artificial ground water recharge planning, modeling, ground water project formation					6
3	Pumping system, water lifting devices, different types of pumping types of pumping machinery, classification of pump, components parts of centrifugal pumps,					6
4	Pump selection, installation, and troubleshooting					3
5	Design of centrifugal pumps, performance curves, effect of speed on head capacity, power capacity and efficiency curve, effect of change of impeller, dimensions on performance characteristics					4
6	Hydraulic ram, propeller pumps, mixed flow pumps and their performance characteristics					4
7	Priming, self-priming devices, roto-dynamic pumps for special purposes such as deep well turbine pump, and submersible pump					3
<b>Total</b>					<b>32</b>	

<b>Practicals</b>		
S.No.	Topic	No. of Practicals
1	Verification of Darcy' s Law	1
2	Study of different drilling equipments	1
3	Sieve analysis for gravel and well screens design	1
4	Estimation of specific yield and specific retention	1
5	Testing of well screen	1
6	Drilling of a tubewell	1
7	Measurement of water level and drawdown in pumped wells	1
8	Estimation of aquifer parameters by Thies method, Coopers- Jacob method , Chow method, Theis Recovery method	1
9	Well design under confined and unconfined conditions, well losses and well efficiency	1
10	Estimating ground water balance	1
11	Study of artificial ground water recharge structures	1
12	Study of radial flow and mixed flow centrifugal pumps, multistage centrifugal pumps, turbine, propeller and other pumps	1
13	Installation of centrifugal pump	1
14	Testing of centrifugal pump and study of cavitations	1
15	Study of performance characteristics of hydraulic ram	1
16	Study and testing of submersible pump	1
<b>Total</b>		<b>16</b>
<b>Reference Books</b>		
<ul style="list-style-type: none"> <li>• Wells and Pumps Engineering, By: S D Khepar and A M Michael,</li> <li>• Pump: Theory &amp; Practices, By: Jain V K</li> <li>• Ground water Hydrology, By: H M Raghunath</li> </ul>		