Third Year B. Tech. Sixth Semester
(Mechanical Engineering)
Academic Year: 2022-2023 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Practical	Oral		
20ME601	Robotics and Control Systems (RCS)	3	0	0	50	50	0	0	100	3
20ME602	Applied Thermodynamics (AT)	2	1	0	50	50	0	0	100	3
20ME603	System Dynamics - Modeling and Simulation (SDMS)	2	1	0	50	50	0	0	100	3
20ME604	Turbo Machines (TM)	2	1	0	50	50	0	0	100	3
20HS601	Industrial Engineering and Operation Research (IIOR)	3	0	0	50	50	0	0	100	3
20OE601	Open Elective II	3	0	0	50	50	0	0	100	3
20ME601L	Robotics and Control Systems (RCS) Lab	0	0	2	25	0	0	25	50	1
20ME602L	Applied Thermodynamics (AT) Lab	0	0	2	25	0	0	25	50	1
20ME603L	System Dynamics - Modeling and Simulation (SDMS) Lab	0	0	2	25	0	25	0	50	1
20ME604L	Turbo Machines (TM) Lab	0	0	2	25	0	0	25	50	1
	Total	**15**	**3**	**8**	**400**	**250**	**25**	**75**	**800**	**22**
	Grand Total	**28**			**650**		**150**			

20OE601 Open Elective-II			Eligible Departments				
Sr. No.	Course Code	Course Title	EnTC	Comp	IT	Mech	Instru
1	20OE601A	Automation and Control Engineering	Y	Y	Y	Y	Y
2	20OE601B	Automotive Electronics	Y	Y	Y	Y	Y
3	20OE601C	Avionics	Y	Y	Y	Y	Y
4	20OE601D	Bioinformatics	Y	Y	Y	N	Y
5	20OE601E	Computer Vision	Y	Y	Y	Y	Y
6	20OE601F	Design Thinking	Y	Y	Y	Y	Y
7	20OE601G	e-Business	Y	Y	Y	Y	Y
8	20OE601H	Electric Vehicles	Y	Y	Y	Y	Y
9	20OE601I	Gamification	Y	Y	Y	Y	Y
10	20OE601J	Geographical Information Systems	Y	Y	Y	Y	Y
11	20OE601K	Multimedia Systems	Y	Y	Y	N	Y

T. Y. B. Tech. -- Semester-II

Course Code	Robotics and Control Systems	L	T	P
20ME601		3	0	0
Prerequisite	Basic Mathematics, Engineering Mechanics, Elements of Electrical and Electronics Engineering	Credit : 03		

Course Objectives:

To familiarize the students

1. Basics of Robotics
2. Robotic control and Actuation
3. Control Technology
4. System Modelling, Stability and Control actions.

Course Outcomes:

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

1. Identification of the basic Robotic systems components and performance parameters
2. Understand the fundamentals of Robotic sensory and actuation systems
3. Analyze the robotic kinematics
4. Identify the basic control systems and it‟s classifications
5. Prepare the system model and can perform the stability analysis of the model
6. Analyze the different controller modes and perform the frequency domain analysis

Unit 1	Introduction to Robotics	5 hours	CO : 1

Basic concepts, Laws of Robotics, Classification, Structure of Robots, Point to point and continuous path control system, Robot performance measurement characteristics- accuracy, resolution, repeatability, precision, dexterity, Industrial Applications.

Unit 2	Robotic Sensors & Actuation	6 hours	CO : 2

Classification, Selection and application, Need for sensors and vision system is robotic control.
Sensors: Light,Soud,Temperature,Contact,Proximity,Distance,Pressure,Tilt,Navigation,Acceleration GPS, IMU, Vision, PVDF Tactile(Construction, working and selection)
Actuation: Selection of Drives, Actuators and transmission system of manipulator.

Machine Vision System: Vision system devices, image acquisition, Masking, Sampling and Quantization, Image processing techniques, Noise reduction, Edge detection, Segmentation.

Unit 3	**Robot Kinematics**	**6 hours**	**CO : 3**
Transformation matrices ,link and joint, Denavit- Hartenberg (D-H) parameters, kinematics redundancy, kinematics calibration, inverse kinematics Static force and velocity in manipulators, Motion of the manipulator links, Jacobians, Singularities, static forces, Jacobian in force domain.			
Unit 4	**Control System**	**6 hours**	**CO : 4**
Definition, Classification- open loop and closed loop control system, case studies, Feedback and Feed Forward Control System, Transfer Function, Block diagram reduction techniques, Signal flow Graphs-Mason's Gain Formula			
Unit 5	**System Modelling and Stability**	**7 hours**	**CO : 5**
Basic system Models: Thermal, Fluid, Hydraulic, Mechanical: Spring-Mass-Damper system equations Stability Analysis in S-Domain: The concept of stability , Poles and Zeros of system – Routh-Hurwitz‟s stability criterion – qualitative stability and conditional stability – Limitations of Routh-Hurwitz‟s stability. Root Locus Technique: Concept of root locus – Construction of root locus. Time domain Response analysis.			
Unit 6	**Controllers and Frequency Response Analysis**	**6 hours**	**CO : 6**
Controllers: On-Off,P,I,D,PI,PD and PID Controller working principle. **Frequency domain specifications**, Bode plot diagrams-Determination of Phase margin and Gain margin, Stability analysis from Bode plots, Polar plots.			
	Total Lecture hours:	**36 hours**	

Text Books:

1.	S.K.Saha, “Introduction to Robotics”, 2nd edition, TataMcGraw Hill Publication,
2.	John J. Craig, “Introduction to Robotics: Mechanics & Control”, 3rd edition, Pearson Education.
3.	Ogata K., “Modern Control Engineering” Prentice Hall of India
4.	Nagrath I.J., & Gopal M, “Control system Engineering.” Wiley Eastern Reprint
5.	C D Johnson, “Process Control Instrumentation Technology”, Prentice Hall of India, New Delhi

Reference Books:

1.	Handbook of design, manufacturing and Automation: R.C. Dorf, John Wiley and Sons
2.	W. Bolton: Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Third Edition, Pearson Education (Low Price Edition)

Course Name	Applied Thermodynamics	L	T	P
Course Code	20ME602	2	1	-
Pre-requisite	Engineering Thermodynamics, Fluid Mechanics, Heat Transfer	Syllabus Version		
		V:1.1		

Course Objectives:

To make students

1. understand performance parameters of reciprocating air compressor.
2. understand and analyze refrigeration cycles
3. understand various psychrometric processes
4. understand performance parameters of gas turbines.

Course Outcomes:

Students will be able to

After successful completion of the course, student will be able to

1. Evaluate isothermal and volumetric efficiency of reciprocating compressor.
2. Analyze refrigeration cycles and calculate COP.
3. Plot psychrometric processes and perform air conditioning load calculations.
4. Calculate the efficiency and power developed for a gas turbine

Unit/Module: 1	Reciprocating Air Compressors	6 hours	CO: 1
Computation of work done, Isothermal efficiency, Volumetric efficiency, Multi staging of compressor, Capacity control of compressor			
Unit/Module: 2	**Refrigeration**	**6 hours**	**CO: 2**
Vapor compression cycle, Multistage refrigeration, Vapor absorption cycle			
Unit/Module: 3	**Psychrometry**	**6 hours**	**CO: 3**
Basic concepts and definitions, Psychrometric chart, Analysis of various psychrometric processes			
Unit/Module: 4	**Gas Turbines**	**6 hours**	**CO: 4**
Working of Brayton Cycle, Thermal Efficiency, Work ratio, maximum & optimum pressure ratio, Actual cycle, Effect of operating variables on thermal efficiency, Inter-cooling, Reheating, and Regeneration cycle			
	Total Course hours:	**hours**	**24**

Text Books:	
1.	S. Domkundwar, C.P. Kothandaraman, A. Domkundwar, Thermal Engineering, Dhanpat Rai & Co
2.	Arora C.P. Refrigeration and Air Conditioning, Tata McGraw-Hill
3.	Manohar Prasad, Refrigeration and Air Conditioning, Wiley Eastern Ltd
4.	V. Ganeshan, Gas Turbines, Tata Mcgraw Hill

Course Name	System Dynamics – Modeling and Simulation	L	T	P
Course Code	20ME603	2	1	0
Pre-requisite	Analysis and Synthesis of Mechanisms, Machine Design, Power Train Design	Credit: 03		

Course Objectives:

1. To understand the methods to find natural frequency of system subjected to undamped free vibrations
2. To analyze the system subjected to vibrations with viscous/coulomb damping
3. To calculate the amplitude and phase difference for various cases of forced vibrations
4. To determine natural frequencies and mode shapes of multiple degree of freedom system
5. To explain the features and applications of various dynamic modeling techniques

Course Outcomes:

Upon completion of this course, the student will be able to,

1. evaluate the natural frequency of system subjected to undamped free vibrations
2. analyze the system subjected to vibrations with viscous/coulomb damping
3. calculate the amplitude and phase difference for various cases of forced vibrations
4. determine natural frequencies and mode shapes of multiple degree of freedom system
5. understand features and applications of various dynamic modeling techniques

Unit 1	Fundamentals of Dynamic System	4 hours	CO: 1

Elements of a vibratory system, S.H.M., degrees of freedom, modeling of a system, concept of linear and non-linear systems, equivalent spring, linear and torsional systems. Matrix Algebra

Unit 2	Single Degree of Freedom Systems – Free and Forced Vibrations	6 hours	CO: 2

Natural frequency by equilibrium and energy methods for longitudinal and torsional vibrations.
Forced vibrations of longitudinal and torsional systems, simple harmonic excitation, excitation due to reciprocating and rotating unbalance, base excitation, magnification factor and phase difference, force and motion transmissibility
Different types of damping, free vibrations with viscous damping - over damped, critically damped and under damped systems, dry friction damping.

Unit 3	Multiple Degree of Freedom Systems - Undamped Vibrations	6 hours	CO: 3

Free vibration of spring coupled systems – longitudinal and torsional, natural frequency and mode shapes. Eigen value and Eigen vector by Matrix method, Geared systems.

Unit 4	**Frequency Response and Vibration**	**6 hours**	**CO: 4**
Digital and Fast Fourier Transform, Frequency Response of first and second order Systems, Vibration Isolator and Vibration Absorption, Response to General Periodic Inputs			
Unit 5	**Dynamic Modeling and Simulation**	**6 hours**	**CO: 5**
Introduction to Laplace Method for Step input, impulse input to SDOF, Laplace Transform, Response for First Order Models, State Space system, Simulations using MATLAB and SIMULINK, Base Excitation, Rotating Imbalance			
	Total Lecture hours:	**28 hours**	

Text Books:	
1.	William J. Palm III, Modeling, Analysis, and Control of Dynamic Systems, Wiley,latest edition
2.	Rao S. S., „Mechanical Vibrations", Pearson Education Inc. Dorling Kindersley (India) Pvt. Ltd.
Reference Books:	
1.	William J. Palm III, System Dynamics, Mc-Graw Hill, latest edition
2.	Grover G. K., „Mechanical Vibrations", Nem Chand and Bros.
3.	Thomson, W. T., „Theory of Vibration with Applications", CBS Publishers and Distributors.
4.	V P Singh, „Mechanical Vibrations", Dhanpat Rai & Sons.
5.	Kelly S. G., „Mechanical Vibrations", Schaum„s outlines, Tata McGraw Hill Publishing Co. Ltd.
6.	Meirovitch, „Elements of Mechanical Vibrations", McGraw Hill.
7.	M.L.Munjal, „Noise and vibration control", Cambridge University Press India Private Limited.
8.	Bies, D. and Hansen, C., „Engineering Noise Control - Theory and Practice", Taylor and Francis.

Course Name	Turbo Machines	L	T	P
Course Code	20ME604	3	1	-
Pre-requisite	Physics, Calculus, Fluid Mechanics	Syllabus Version		
		V:1.1		

Course Objectives:

Course prepares students to

1. differentiate between impulse and reaction turbine
2. illustrate inlet and outlet conditions of a turbomachine with the help of velocity triangles
3. calculate the head requirement and efficiency of a centrifugal pump
4. determine the slip and efficiency of a centrifugal compressor

Course Outcomes:

Students will be able to

1. Compute the power developed and efficiency of hydraulic turbine
2. Determine head developed by a centrifugal pump and power required to operate it
3. Calculate the diagram efficiency and diagram power for a given steam turbine
4. Perform calculations for the power developed and efficiency for gas turbine
5. Construct velocity triangles and calculate thermal efficiency of centrifugal compressor

Unit/Module: 1	Introduction	4 hours	CO: 1

Turbo machines (Hydraulic & Thermal), Classification of Turbo machines, Comparison with positive displacement machines, Fundamental equation governing turbo machines, Concepts of Velocity triangle and impact of jet on curved vanes

Unit/Module: 2	Hydraulic Turbines	8 hours	CO: 2

Pelton wheel- Construction, principle of working, velocity diagrams and analysis, design aspects,
Reaction Water Turbines : Classifications, Francis, Propeller, Kaplan Turbines, construction features, velocity diagrams and analysis, degree of reaction,

Unit/Module: 3	Steam Turbine	8 hours	CO: 3

Steam Turbines: Classifications (Axial and Radial), construction details, compounding of steam turbines, velocity diagrams and analysis of Impulse and reaction turbines (single stage), governing of steam turbines

Unit/Module: 4	**Centrifugal Pump**	**8 hours**	**CO:4**
Classification of rotodynamic pumps, components of centrifugal pump, types of heads, velocity triangles and their analysis, effect of outlet blade angle, cavitation, NPSH, specific speed, performance characteristics of centrifugal pump, Cavitation, open, semi open impeller pumps			
Unit/Module: 5	**Centrifugal Compressor**	**8 hours**	**CO: 5**
Classification of rotodynamic compressors, blowers, fans. Centrifugal compressor: Construction, flow process on T-S Diagram, velocity diagram and Euler's work, slip factor and its effect on work input, actual work input, dimension parameters, surging, choking, stalling.			
	Total Lecture hours:	**36 hours**	

Text Books:

1	Jagdish Lal, Hydraulic Machines, Metropolitan Book Company
2	Kadambi & Prasad, An Introduction To Energy Conversion: Turbomachinery - Vol. III, New Age International
3	William W. Peng, Fundamentals of Turbomachinery, John Wiley & Sons.
4	Turbines, Compressors & Fans, S.M. Yahya, Tata-McGraw Hill
5	S.L. Dixon, Fluid Mechanics, Thermodynamics of Turbomachinery, IV edition, Butterworth-Heinemann Publ., 1966.
6	R. K. Rajput Hydraulic Machines, S. Chand
7	V. Ganeshan, Gas Turbines, Tata Mcgraw Hill

Course Name	**Industrial Engineering and Operations Research [IEOR -** OEHS]	**L**	**T**	**P**
Course Code	**20OEHS601**	**3**	**-**	**-**
Pre-requisite	Manufacturing Process, Industrial Inspection, Quality Control	**Syllabus Version**		
		V:1.1		

Course Objectives:

Course prepares students to

1. Effectively explain production planning and Control functions.
2. Understand different types of analysis using industrial engineering techniques viz. Method Study and Work Measurements
3. Develop mathematical skills to analyse Project Scheduling arising from a wide range of applications.
4. Understand procedure for Replacement and Queuing System analysis

Course Outcomes:

Students will be able to

1. Analyze different types of production planning functions viz. productivity analysis, Aggregate and Capacity production planning, forecasting, inventory control,
2. Apply method study and work measurements technique to solve industrial problem,
3. Analyze the given Project for optimum schedule and sequence.
4. Analyze the given industrial situation to optimize replacement decision and queuing problem

Unit/Module: 1	**Industrial Engineering, Productivity and PPC**	**6 hours**	**CO: 1**

- **Industrial Engineering:** Objectives, Functions & Tools; Production Systems and Organisation structures: Types, Strategies & Principles
- **Productivity Analysis:** Definition, Factors Affecting the Productivity, Productivity models and index (numerical);
- **Production Planning and Control:** Functions of PPC, Aggregate production planning; Capacity Planning, ERP

Unit/Module: 2	**Production Forecasting and Facility Planning**	**6 hours**	**CO: 1**

- **Forecasting Techniques**: Qualitative and Quantitative Methods: Causal and time series models, moving average, exponential smoothing, trend and seasonality (Numerical)
- **Facility Layout Planning**: Factors Influencing, Material Flow Patterns, Tools & Techniques

used

- **Inventory Control:** Inventory costs, Types of inventory models - Deterministic and Probabilistic, Concept of EOQ, purchase model without shortages (Numerical); ABC and VED Analysis (Numerical).

Unit/Module: 3	**Method Study and Work Measurements**	**8 hours**	**CO: 2**

- **Method Study:** Definition, objective and procedural steps; activity recording tools, Human factors considerations; Value Engineering
- **Work measurement:** Definition, objectives and techniques: **Time study & Work sampling**, (numerical); **Synthetic motion studies**: PMTS and MTM, MOST

Unit/Module: 4	**Project Scheduling**	**8 hours**	**CO: 3**

- **Critical Path Method (CPM)**: Network Diagram;
- **Program Evaluation and Review Technique (PERT)**: Problems, Time Cost Trade Off (Crashing),
- **Jobs Sequencing**: „N" Jobs & 2 / 3 Machines
- **Jobs Assignment**:

Unit/Module: 5	**Replacement and Queuing System analysis**	**8 hours**	**CO: 4**

- **Replacement analysis**: Maintenance cost increases with time and the value of money remains same / increases during the period; replacement of items that fail completely and suddenly.
- **Queuing System analysis**: M / M / 1 / (□/ FIFO); (FCFS/□/□): (Birth – Death process)

	Total Lecture hours:	**36 hours**	

Text Books:

1.	Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBH
2.	Zandin K.B. - Most Work Measurement Systems, ISBN 0824709535, CRC Press, 2002.
3.	Industrial engineering and management by O. P. Khanna, Dhanpatrai publication
4.	Industrial Engineering , Martend Telsang, S. Chand Publication
5.	Industrial Organisation & Engineering Economics by Banga and Sharma, Khanna publication.
6.	Prem Kumar Gupta and D S Hira, Operations Research, S Chand in publication 2007.
7.	J. K. Sharma, Operations Research: Theory And Application, Laxmi pub. India.

Reference Books:

1.	H.B. Maynard, KJell, Maynard"s Industrial Engineering Hand Book, McGraw Hill, Education, 2001
2.	Taha, H. A. 2007, Operations Research, 8th Edn, Pearson.

Course Name	Robotics and Controls Lab	L	T	P
Course Code	20ME601L	-	-	2
Pre-requisite	Engineering Mechanics, Elements of Electrical and Electronics Engineering	Syllabus Version		

Course Objectives:

To familiarize the students with the

1. Basics of robots and robotic manipulator components
2. Control system and controller actions
3. Industrial application of robotics and Controllers

Course Outcomes:

Students will be able to

After successful completion of the course, student will be able to

1. Identify the elements of robotics and apply the knowledge to design simple control system.
2. Perform forward and Inverse kinematic analysis of robotic system.
3. Integrate different types of sensors and control the basic robotic motion.
4. Identify and Apply the knowledge of basic concepts of robotic system and its components.

1	Study components of an industrial robot (PUMA, KUKA, FANUC, MTAB , UR , Etc) and its DH parameters.
2	Forward kinematics and validation using suitable software (Robo Analyser/ MatLab or any other free software tool).
3	Inverse kinematics of an industrial robot and validation using any open source software
4	Integration of assorted sensors (IR, Potentiometer, strain gages etc.), micro controllers in a robotic system. (Free software, Matlab)
5	Control experiment using available hardware or software. (Open source or Matlab).
6	Tunning of PID Controller for suitable application.

	7	Small group project work relevant to Industrial automation.		
	8	Industrial visit to any Robotic assembly line or Robot assisted manufacturing.		
		Total Lab hours:	**hours**	**20**

Textbooks:	
1.	Introduction to Robotics : J. Craig , Pearson
2.	Robot Dynamics and Control, Spong & Vidyasagar, Mc Graw Hill
3.	Robotics : Subir K Saha , Mc GrawHill
4.	Industrial Robotics : M. P. Groover, Ashish Dutta , McGraw Hill
5.	S.R.Deb, "Robotic Technology and Flexible Automation".TataMcGraw Hill Publication.

Course Name	Applied Thermodynamics Lab	L	T	P
Course Code	20ME602 L	-	-	2
Prerequisite	Engineering Thermodynamics, Fluid Mechanics, Heat Transfer	Syllabus Version		
		V:1.1		

Course Objectives:

1. To study performance parameters of I C Engines.
2. To conduct trial and do performance calculations for reciprocating air compressor
3. To evaluate performance of refrigeration cycles
4. To analyze various psychrometric processes

Course Outcomes:

After successful completion of the course, students will be able to

1. Conduct trial on IC engines and calculate performance parameters.
2. Conduct trial on reciprocating air compressor to ascertain volumetric and isothermal efficiency.
3. Compute performance parameters of vapor compression refrigeration system
4. Perform a trial on air conditioning tutor to understand different psychrometric processes.

Lab Work:

1. Study and trial on petrol engine.
2. Study and trial on Diesel engine
3. Morse Test on multi cylinder petrol/Diesel engine for determination of friction power.
4. Trial on vapor compression test rig.
5. Trial on ice plant test rig.
6. Trial on air conditioning test rig.
7. Trial on two stage reciprocating air compressor.
8. Visit to the air conditioning plant.
9. Assessment of mini project in Thermal Engineering.

Text Books/References:

1.	V. Ganesan, Internal Combustion Engines, Tata McGraw Hill
2.	M.L. Mathur and R.P. Sharma, A course in Internal Combustion Engines, Dhanpat Rai Publications
3.	S. Domkundwar, C.P. Kothandraman, A. Domkundwar, Thermal Engineering, Dhanpat Rai & CO
4.	Arora C. P., Refrigeration and Air Conditioning, Tata McGraw Hill

Course Name	System Dynamics – Modeling and Simulation Lab	L	T	P
Course Code	20ME603L	-	-	2
Prerequisite	1.Analysis and Synthesis of Mechanisms 2.Machine Design 3.Power Train Design	Syllabus Version		
Co -requisites:	System Dynamics - Modeling and Simulation	V:1.1		

Course Objectives:

1.To understand the methods to find natural frequency of system subjected to undamped free vibrations
2.To determine natural frequencies and mode shapes of multiple degree of freedom system
3.To understand the implications of rotating imbalance
4.To explain the features and applications of various dynamic modeling techniques

Course Outcomes:

Upon completion of this course, the student will be able to,

1.evaluate the natural frequency of system subjected to un-damped free vibrations
2.determine natural frequencies and mode shapes of multiple degree of freedom system
3. perform experiment of rotating imbalance
4. understand features and applications of various dynamic modeling techniques

Text Books/References:

	William J. Palm III, Modeling, Analysis, and Control of Dynamic Systems, Wiley, latest edition

List of Experiments:

1	MATLAB and some Functions
2	Data Acquisition Basics + SDOF Undamped
3	Cantilever Beam (SDOF System)
4	SDOF Simulation – MATLAB SIMULINK –Underdamped Free Vibrations
5	SIMULINK Examples and Numerical Methods
6	Air Track SDOF and 2DOF Free Vibration
7	Eigenvalue in MATLAB/Simulation of 2 DOF system
8	Rotating Imbalance

Course Name	Turbo Machines Lab	L	T	P
Course Code	20ME604L	-	-	2
Pre-requisite	Fluid dynamics	Syllabus Version		

Course Objectives:

To make students

1. To conduct experiments involving various parameters of different turbo machines
2. To calculate hydraulic and overall efficiency of a given hydraulic turbine
3. To Illustrate the characteristics in the graphical form
4. To Compare the results with available characteristic curves and deduce the conclusion from it

Course Outcomes:

Students will be able to

After successful completion of the course, student will be able to

1. conduct experiments involving various parameters of different turbo machines
2. calculate hydraulic and overall efficiency of a given hydraulic turbine
3. Illustrate the characteristics in the graphical form
4. Compare the results with available characteristic curves and deduce the conclusion from it

1. Verification of impulse moment principle using impact of jet on curved vane
2. Study and constant speed trial on impulse water turbine (Pelton wheel) and plotting of main and operating characteristics
3. Study and constant head trial on impulse water turbine (Pelton wheel) and plotting of main and operating characteristics
4. Study and constant speed trial on any hydraulic reaction turbine and plotting of main and operating characteristics
5. Study and constant head trial on any hydraulic reaction turbine and plotting of main and operating characteristics
6. Study and trial on centrifugal pump and plotting operating characteristics Study and trial of rotary compressors.
7. Visit to hydro/steam power plant and report to be submitted.
8. Performance Test on Gear (Oil) Pump Test Rig

	Total Lab hours:	hours	20