Chhattisgarh Swami Vivekanand Technical University, Bhilai

SCHEME OF TEACHING AND EXAMINATION

B.E. VI SEMESTER MECHANICAL ENGINEERING

S. No.	Board of Study	Sub. Code	SUBJECT	PERIODS PER WEEK			SCHEME OF EXAM Theory/Practical			Total Marks	Credit L+(T+P)/2
				L	T	P	ESE	CT	TA		
1.	Mech. Engg	**337651 (37)**	Machine Design – II	4	1	-	80	20	20	120	5
2.	Mech. Engg	**337652 (37)**	Energy Systems	4	1	-	80	20	20	120	5
3.	Mech. Engg	**337653 (37)**	Internal Combustion Engines	4	1	-	80	20	20	120	5
4.	Mech. Engg	**337654 (37)**	Heat & Mass Transfer	4	1	-	80	20	20	120	5
5.	Mech. Engg	**337655 (37)**	Production Management	3	1	-	80	20	20	120	4
6.	***Refer Table I***		Professional Elective-I	4	1	-	80	20	20	120	5
7.	Mech. Engg	**337661 (37)**	Machine Design-II Lab	-	-	2	40	-	20	60	1
8.	Mech. Engg	**337662 (37)**	Internal Combustion Engines Lab	-	-	2	40	-	20	60	1
9.	Mech. Engg	**337663 (37)**	Production Management Lab	-	-	2	40	-	20	60	1
10.	Mech. Engg	**337664 (37)**	HMT Lab	-	-	2	40	-	20	60	1
11.	Management	**300665 (76)**	Managerial Skills	-	-	2	-	-	40	40	1
12.	Mech. Engg	----------	Library	-	-	1	-	-	-	-	-
Total				**23**	**6**	**11**	**640**	**120**	**240**	**1000**	**34**

L: Lecture **T:** Tutorial **P:** Practical
ESE: End Semester Examination **CT:** Class Test **TA:** Teacher's Assessment

Note: Industrial Training of eight weeks is mandatory for B.E. students. It is to be completed in two equal parts. The first part must have been completed in summer after IV semester. The second part to be completed during summer after VI semester after which students have to submit a training report which will be evaluated by college teachers during B.E. VII semester.

Table – 1
Professional Elective – I

S. No.	Board of Study	Subject Code	Subject
1	Mechanical Engineering	**337671 (37)**	Industrial Hydraulics
2	Mechanical Engineering	**337672 (37)**	Control Engineering
3	Mechanical Engineering	**337673 (37)**	Engineering Economics
4	Mechanical Engineering	**337674 (37)**	Composite Materials
5	Mechanical Engineering	**337675 (37)**	Power Plant Engineering
6	Mechanical Engineering	**337676 (37)**	Maintenance and Reliability
7	Mechanical Engineering	**337677 (37)**	Computer Graphics

Note (1) – 1/4th of total strength of students subject to minimum of twenty students is required to offer an elective in the college in a particular academic session.
Note (2) – Choice of elective course once made for an examination cannot be changed in future examinations.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	**Mechanical Engineering/Mechatronics Engineering**	Semester:	**VI**
Subject:	**Machine Design II**	Code:	**337651(37)**
Total Theory Periods:	**40**	Total Tutorial Periods:	**10**
No. of class Tests to be conducted:	**2 (Minimum)**	No. of assignments to be submitted:	**2 (Minimum)**

ESE Duration: **Four Hours** Maximum Marks in ESE: **80** Minimum Marks in ESE: **28**

Note: Design data book by PSG and ISI data sheets are allowed in the examination.

Course Objectives

- To design and analyze coil, leaf and laminated springs.
- To design and analyze spur, helical and bevel gears.
- To design and analyze rolling contact bearings.
- To design and analyze journal bearing.

To design and analyze chain and belt drive.

Course outcomes:

- Apply knowledge of machine design for understanding, formulating and solving engineering problems.
- Acquire knowledge and hands-on competence in applying the concepts in the design and development of mechanical systems.
- Demonstrate creativeness in designing new systems components and processes in the field of engineering in general and mechanical engineering in particular.
- Identify, analysis, and solve mechanical engineering problems useful to the society.
- Work effectively with engineering and science teams as well as with multidisciplinary designs.

UNIT I **Spring:** Spring materials and their mechanical properties, equation for stress and deflection, helical coil springs of circular section for tension, compression and torsion, dynamic loading, fatigue loading, Wahl line, leaf spring and laminated spring.

UNIT II **GEARS: Spur Gears -** Gear Drives, Classification of Gears, Selection of Type of Gears, Law of Gearing, Force Analysis, Gear Tooth Failures, Selection of Material, Number of Teeth, Face Width, Beam Strength of Gear Tooth, Effective Load on Gear Tooth, Estimation of Module Based on Wear Strength, Lewis equation, Gear Design for Maximum Power Transmitting Capacity, Gear Lubrication.

UNIT III **Helical Gears:** Helical Gears, Terminology of Helical Gears, Virtual Number of Teeth, Tooth Proportions, Force Analysis, Beam Strength of Helical Gears, Effective Load on Gear Tooth, Wear Strength of Helical Gears.
Bevel Gears: Bevel Gears, Terminology of Bevel Gears, Force analysis, Beam strength of Bevel Gears, Wear Strength of Bevel Gears, Effective Load on Gear Tooth.

UNIT IV **Bearings: Rolling Contact Bearings -** Types of ball and roller bearings, selection of bearing for radial and axial load, bearing life, Mounting and lubrication, shaft scales – contact type and clearance type.
Journal Bearings: Types of lubrication, viscosity, Hydrodynamic theory of lubrication, Sommerfeld number, heat balance, self-contained bearings, bearing materials.

UNIT V **Chain Drives:** Chain drives, roller chains, geometric relationships, dimensions of chain components polygonal effect, power rating of roller chains.
Belt Drives: Flat and V-belts, belt constructions, geometrical relationships for length of the belt, analysis of belt tensions, condition for maximum power, selection of flat & V-belts, adjustment of belt tensions, Wire ropes, stresses in wire ropes

TEXT BOOKS:

1. Design of Machine Elements - V.B. Bhandari, TMH Publications, Delhi
2. Machine Design - Shigley – McGraw Hill, DelhiNoida

REFERENCE BOOKS:

1. Machine Design - Movnin – MIR Publishers, Moscow
2. Machine Design - Fundamental & Application – Gope –PHI, New Delhi
3. Machine Design - Sharma & Agrawal – Katson, New Delhi
4. Principles of Mechanical Design - R. Phelan – McGraw Hill, New Delhi.
5. Machine Design – Sundarajamoorthy & Shanmugum– Anuradha, Chainnai

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	**Mechanical Engineering**	Semester:	**VI**
Subject:	**Energy Systems**	Code:	**337652(37)**
Total Theory Periods:	**40**	Total Tutorial Periods:	**10**
No. of class Tests to be conducted:	**2 (Minimum)**	No. of assignments to be submitted:	**2 (Minimum)**
ESE Duration:	**Three Hours**	Maximum Marks in ESE: **80**	Minimum Marks in ESE: **28**

Course Objectives

- To understand the construction and operation of various jet and rocket engine
- To analyze jet engine and rocket engine from fluid and thermodynamic principle
- To study important non-conventional energy resources and the technologies for harnessing these.

Course Outcome:

- Demonstrate a basic understanding of jet and rocket engine design, function and performance.
- Acquire knowledge and hands-on competence in the design and development of mechanical systems.
- Compare different non-conventional energy resources and choose the most appropriate based on local conditions
- Perform simple techno-economical assessments of non-conventional energy resources
- Perform and compare basic environmental assessments of non-conventional energy resources and conventional fossil fuel systems
- Design renewable/hybrid energy systems that meet specific energy demands, are economically feasible and have a minimal impact on the environment

UNIT I **Propulsion Devices:** Types of jet engines, Ram Jet, pulse jet, Turbojet, Turbo propulsion, principle and operation. Energy flow through jet and variation of pressure and temperature, thrust equation, specific thrust and velocity of fluid. Thermodynamics of turbojet, efficiency & performance, parameters affecting performance, after burn, Injection of water & alcohol mixture.

UNIT II **Rocket Propulsion:** Basic theory, Physics equations, classifications, types of rocket engines, liquid propellant rockets, efficiency and performance, orbital & escape velocity application of space flight.

UNIT III **Non-Conventional Energy Conversion:** Classical sources of energy crisis and search for alternative sources of energy. **Solar energy:** Introduction,, earth sun angles, resolution, solar measurement, collection of solar energy, flat plate and focusing collector analysis, calculations ,design parameters.
Applications of solar energy. Introduction to photovoltaic cell energy conversion techniques.

UNIT IV **Bio-Mass:** Introduction, Bio-mass conversion technologies, bio-gas generation, classification of bio-gas plant, Gasifiers, Gobar gas plant, applications. **Wind Energy:** Basic principles of wind energy conversion, wind energy estimation, site selection consideration, basic components of wind energy conversion system, classification, advantages & disadvantages of WECS.

UNIT V **Additional Alternate Energy Sources & Improved Energy Utilization:** Fuels cell technology, wave energy conversion, tidal energy conversion, ocean thermal energy conversion (OTEC). Principle of Magneto hydrodynamics (MHD)power system, types of MHD system, advantages, materials for MHD system.
Geothermal energy, nature of geothermal fields, geothermal sources, prime movers for geothermal energy, advantages, disadvantages of geothermal energy over other energy forms, its application.

TEXT BOOKS

1. Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion – S.M.Yahya – New Age International Publishers, Delhi
2. Non-Conventional Energy Sources - G.D. Rai – Khanna Publishers

REFERENCE BOOKS

1. Gas Dynamics & Space Propulsion – N. Shanmugam, M. Palani – Anuradha Agencies
2. Fundamental of Compressible Fluid Dynamics – P. Balachandran – PHI
3. Gas Turbine Theory & Jet Propulsion – J.K. Jain – Khanna Publishers,Delhi
4. Solar Energy -Fundamentals and Applications– H.P.Garg & J. Prakash – TMH ,Delhi
5. Non Conventional Energy Sources – Saeed, Hasan and DK Sharma, SK Kataria,Delhi
6. Non Conventional Energy Resources- DSChauhan, and Srivastava, New Age,Delhi
7. Biogas Technology-B.T.Nijaguna,- New Age ,Delhi
8. Solar Energy – Principles of Thermal Collection and Storage- R Sukhatme- THM Delhi
9. Non Conventional Energy Resources: Alternative Energy Sources And Systems- R.K.Singhal, Kataria ,Delhi

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	**Mechanical Engineering**	Semester:	**VI**
Subject:	**Internal Combustion Engine**	Code:	**337653(37)**
Total Theory Periods:	**40**	Total Tutorial Periods:	**10**
No. of class Tests to be conducted:	**2 (Minimum)**	No. of assignments to be submitted:	**2 (Minimum)**
ESE Duration:	**Three Hours**	Maximum Marks in ESE: **80**	Minimum Marks in ESE: **28**

Course Objectives

- To study classifications of internal combustion engine.
- To understand how and why actual cycles deviate from air standard cycle and fuel-air cycle.
- To understand combustion in spark ignition engine and diesel engines.
- To impart knowledge on fuel and its specifications
- To impart knowledge about carburetion, gasoline injection and diesel injection.
- To impart knowledge about ignition, cooling, lubrication and governing systems.
- To impart knowledge about various engine performance characteristics and its testing

Course Outcome:

- Demonstrate a basic understanding of engine design, function and performance.
- Acquire knowledge and hands-on competence in the design and development of mechanical systems.
- Work effectively with engineering and science teams as well as with multidisciplinary designs.
- Demonstrate an understanding of the relationships between the design of the internal combustion engine and environmental issues

UNIT I **a) Introduction:** Internal and external combustion engine and their comparison, four stroke cycle S.I. and C.I. engine, two stroke engine, comparison of four stroke and two stroke engines, comparison of S.I. and C.I. engine, classification of I.C. Engine on various basis Valve timing diagram for S.I. and C.I. engines. Effect of valve timing and engine speed on volumetric efficiency.
b) Fuel-air cycles and actual cycle: Reasons for deviation of actual cycle from air standard cycles, fuel air cycles and their analysis, actual cycles and their analysis. Reasons of ignition advance and injection advance

UNIT II **a) Combustion:** Combustion in S.I. engine, stages of combustion, factor influencing the flame speed, the phenomenon of knock in S.I. engine, effect of engine variable on knock, effects of detonation, Pre-ignition, effect of preignition. Combustion in C.I. engine: stages of combustion, factor influencing the delay period,, the phenomenon of knock in C.I. engine, effect of engine variable on knock, comparison between knock in S.I. and C.I. engine.
b) Fuels: Basic requirement of I.C. Engine fuels, requirement of an ideal gasoline, structure of petroleum, effect of fuel structure on combustion, volatility of liquid fuels, ASTM distillation curve, effect of volatility on engine performance - cold starting, hot starting, vapour lock, acceleration, carburetor icing, and crank case dilution. Antiknock rating of fuels, CCR, HUCR, Octane number, performance number, Cetane number. Dopes.

UNIT III **Carburetion:** Properties of air-petrol mixtures, mixture requirement, simple carburetor, limitation of simple carburetor, Nozzle lip, venturi depression, calculation of fuel jet and venturi throat diameter for given air fuel ratio. Element of complete carburetor, main metering system-compensating jet device, Idling system, power enrichment system, acceleration pump and cold starting system. Gasoline injection system: Disadvantages of carburetor, Type of injection system, components of injection system, Electronic gasoline fuel injection system, multi-point fuel injection system, working, advantages and disadvantages.

UNIT IV **Injection System for C.I. Engines:** Requirement, type of injection systems, Bosch fuel injection pump, type of fuel injector, type of nozzle, atomization, spray penetration and spray direction. Electronic diesel injection System.
Ignition System: Battery and magneto ignition system and their comparative study, spark plug heat range, electronic ignition system, firing order, Ignition timing, centrifugal and vacuum ignition advance.
Cooling System: Cooling requirement, air cooling, liquid cooling, type of liquid cooling system, advantage and disadvantage of air cooling and water cooling system, Antifreeze mixture.
Lubrication System: Function of lubricating system, Classification of lubricating system, mist lubrication system, dry sump lubrication, wet sump lubrication-splash, and modified and full pressure system
Governing: Necessity of governing, methods of governing-hit and miss governing, quantity governing and quality governing

UNIT V Testing and Performance: Performance parameters, measurements of brake power, indicated power, measurement friction power-Willan's line method, Morse test, motoring test, measurement fuel consumption, and measurements of air consumption, exhaust gas calorimeter. Calculation of various performance parameter, heat balance sheet and heat balance diagram. Performance curves of S.I. and C.I. Engine at full throttle variable speed operation and at constant speed variable load operation.

TEXT BOOKS:

1. A Course in Internal Combustion Engines – M.L. Mathur & R.P. Sharma – Dhanpat Rai & Sons,Delhi
2. Internal Combustion Engine – V. Ganeshan – TMH, New Delhi

REFERENCE BOOKS:

1. Internal Combustion Engine – R. Yadav – Central Publishing House, Allahabad
2. A Course in Internal Combustion Engine – V.M. Domkundwar – Dhanpat Rai & Sons,Delhi
3. Internal Combustion Engines – R.K.Rajput – Laxmi Publications
4. Internal Combustion Engine Fundamentals-John B. Heywood- McGraw Hill International, Delhi
5. Fundamental of Internal Combustion Engine – Paul W. Gill, James H. Smith, Eugene – Oxford and IBH Publishing Company
6. Fundamental of Internal Combustion Engine- H.N. Gupta-PHI- New Delhi
7. Engineering Fundamentals of the Internal Combustion Engine- Pulkrabek, Willard W-PHI Delhi
8. Elements of Internal Combustion Engines- A R Rogowski- TMH. New Delhi
9. A Textbook of Internal Combustion Engine Dr.R.K.Singhal- Standard Book House, Delhi
10. Automotive Mechanics: Principles And Practices- W.H.Crouse, and D.L. Anglin, TMH ,Delhi

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	**Mechanical Engineering**	Semester:	**VI**
Subject:	**Heat & Mass Transfer**	Code:	**337654(37)**
Total Theory Periods:	**40**	Total Tutorial Periods:	**10**
No. of class Tests to be conducted:	**2 (Minimum)**	No. of assignments to be submitted:	**2 (Minimum)**
ESE Duration:	**Three Hours**	Maximum Marks in ESE: **80**	Minimum Marks in ESE: **28**

Course Objectives

- To provide a fundamental understanding of the principles of heat transfer due to conduction, convection and radiation.
- To achieve an understanding of the basic concepts of phase change processes.
- To understand the principles of mass transfer.
- To learn about the design of heat exchangers.

Course Outcome:

- Apply knowledge of heat transfer for understanding, formulating and solving engineering problems.
- Acquire knowledge and hands-on competence in applying the concepts of heat and mass transfer in the design and development of mechanical systems.
- Demonstrate creativeness in designing new systems components and processes in the field of engineering in general and mechanical engineering in particular
- Identify, analysis, and solve mechanical engineering problems useful to the society.
- Work effectively with engineering and science teams as well as with multidisciplinary designs.

UNIT I

Introduction: Heat transfer, Difference between heat transfer and thermodynamics, Various modes of heat transfer, Fourier's, Newton's and Stefan Boltzman's Law, Combined modes of heat transfer, thermal diffusivity, overall heat transfer coefficient. The thermal conductivity of solids, liquids and gases, factors influencing conductivity

Conduction : Heat conduction without heat generation: Derivation of general differential equation of heat conduction in Cartesian co-ordinate. One dimensional steady state conduction, linear heat flow through a plane and composite wall, heat conduction without heat generation in cylinder and sphere, critical thickness of insulation. Conduction with heat generation in flat wall and solid cylinder.

UNIT II

Heat transfer from extended surface (Fins): Types of fins, Fin equation for uniform cross sectional area (rectangular profile), Solution for infinite length, negligible heat loss from fin tip, finite long and heat transfer from fin tip. Fin effectiveness and efficiency. Error in temperature measurement from thermometer.

Transient/Unsteady State Heat Conduction: Lumped system analysis, criteria for lumped system analysis, solution of transient heat conduction in large plane wall, long cylinders and sphere through Heisler`s chart.

UNIT III

Forced Convection: Physical Mechanism of Forced Convection, Dimensional analysis for forced convection, velocity and Thermal Boundary layer, Flow over plates, Flow across cylinders and spheres, Flow in tubes, Reynold's analogy.

Natural Convection: Physical Mechanism of Natural Convection, Dimensional analysis of natural convection; empirical relationship for natural convection.

UNIT IV

Two Phase Heat Transfer: Boiling heat transfer, Pool boiling, boiling regimes and boiling curve, heat transfer correlations in pool boiling. Condensation heat transfer, Film condensation, derivation for the average heat transfer coefficient 'h' for the case of laminar film condensation over vertical plate, Heat transfer correlation for inclined plates, vertical tubes, Horizontal bank tubes.

Introduction to Mass Transfer : Mass and mole concentrations, molecular diffusion, eddy diffusion, Molecular diffusion from an evaporating fluid surface, Introduction to mass transfer in laminar and turbulent convection Combined heat and mass transfer, the wet and dry bulb thermometer.

UNIT V

Heat Exchangers: Different types of heat exchangers; Determination of heat exchanger performance, Heat exchanger transfer units, Analysis restricted to parallel and counter flow heat exchanger (LMTD and NTU method)

Thermal Radiation: Introduction, absorbtivity, reflectivity & transmissivity. Concept of black body & grey body. Emissive power of surface, Kirchoff's law, emissivity , Concept of shape factor.

Radiat heat exchange between two parallel grey surface and concentric cylinders.

Errors in temperature measurement due to radiation. Concept of irradiation and radiosity.

TEXT BOOKS:

1. Heat Transfer – S.P. Sukhatme – TMH,Delhi
2. Heat & Mass Transfer – D.S. Kumar – S.K. Kataria & Sons,Delhi

REFERENCE BOOKS:

1. Heat transfer- C P Arora, TMH,Delhi
2. Heat & Mass Transfer – R, Yadav, Central Publishing House, Allahabad
3. Heat & Mass Transfer – R.K. Rajput, S.Chand, Delhi
4. Heat & Mass Transfer – P.K. Nag, TMH, Delhi
5. Heat Transfer – J.P. Holman – TMH, Delhi
6. Heat Transfer – A Practical Approach – Yunus A. Cengel – McGraw Hill ,Delhi
7. Heat Transfer – P.S. Ghoshdastidhar – Oxford University Press
8. Heat And Mass Transfer Fundamentals And Applications- Cengel, Yunus, A and AJ Ghajar, TMH, Delhi
9. A Course In Heat And Mass Transfer- S.C. Arora & S Donkundwar, S- Dhanpat Rai,Delhi
10. Heat and Mass Transfer Data Book- C.P.Kothandaraman C.P. & S. Subramanyan , New Age, Delhi

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	**Mechanical Engineering**	Semester:	**VI**
Subject:	**Production Management**	Code:	**337655(37)**
Total Theory Periods:	**40**	Total Tutorial Periods:	**10**
No. of class Tests to be conducted:	**2 (Minimum)**	No. of assignments to be submitted:	**2 (Minimum)**
ESE Duration:	**Three Hours**	Maximum Marks in ESE: **80**	Minimum Marks in ESE: **28**

COURSE OBJECTIVES:

1. To understand the basic concept of production management.
2. To understand the concept of breakeven analysis.
3. To learn the different methods to solve problems in sales forecasting.
4. To understand the concept of planning, organizing & controlling.
5. To understand the various models of inventory control.
6. To understand the methods of purchasing & store keeping.
7. To understand & analyze the various methods of quality control problems.

COURSE OUTCOMES:

1. Acquire knowledge recognize and perform the job of a competent production manager.
2. Identify, analyze and solve production engineering related problemsin planning, decision-making, and expense control.
3. Understand the performance to establish setting goals & predicting expenses and planning budgets.
4. Work effectively with engineering and science teams as well as with multidisciplinary designs.
5. Skillfully use modern engineering tools and techniques in various production areas.
6. Additionally, this course will help the student to be a committed to quality, timeliness, and continuous improvement.
7. Pursue higher studies.

UNIT I **Production Management:** definition, objectives, scope, benefits, functions of production management, place of production management in an organization, types of production system, Product life cycle, product design and development, production cycle.

Costing and Cost Analysis: Elements of costs, Break even analysis, Incremental costs, make or buy decision.

UNIT II **Sales Forecasting**: Purposes, methods -Delphi, linear regression, economic indicators, time-series analysis, adjustment for seasonal variations, moving average, exponential smoothing.

UNIT III **Production Planning and Control:** Functions, Organization, Master Scheduling, Aggregate planning and strategies ,Materials Requirement Planning, product structure tree, Routing, Loading Scheduling –forward and backward, Dispatching

–priority rules, Sequencing, Johnson's algorithm for n jobs and two machines, Gantt's chart, Bar chart, Flow process chart.

Materials Handling: Principles of materials handling, unit load, Types of materials handling equipment, Relation between materials handling and plant layout.

UNIT IV **Material Management:** Objectives and functions of materials management, Organization of materials management.

Procurement: Objectives of purchase department, purchase responsibilities and organization, types of purchasing, purchase procedures, Import and Export.

Stores Keeping: Stores management, functions of stores, classification of materials, standardization of materials, identification and maintenance of layout of stores, physical control of materials, pricing of stores, issuing of stores.

Inventory Control: Objective, scope and functions of inventory control, inventory control techniques, economic ordering quantity, periodic ordering quantity, A.B.C. analysis, General idea regarding inventory control under risk and uncertainty.

UNIT V **Quality Control:** Difference between inspection and quality control, acceptance sampling, procedure's risk and consumer's risk, operating characteristic curve for single sampling plan, AOQL

Quality of conformance, quality of design, economics of quality, SQC charts for variables and attributes.

Introduction to JIT manufacturing, Kanban system.

TEXT BOOKS:

1. Production and operation Management–By P. Ramamurty –New Age International Publication,New Delhi
2. Production and operation Management –By R. Mayer –TMH,New Delhi
3. Quality Planning and Analysis, Juran and Gryna

REFERENCE BOOKS:

1. Industrial Engineering & Production Management –Martand Telsang, S.Chand & Co
2. Production and operations Management by –Adam and Ebert –PHI ,New Delhi
3. Production planning and Control –By Samuel Eilon, Navneet Prakashan Ltd., Bombay

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	**Mechanical Engineering**	Semester:	**VI**
Subject:	**Machine Design - II Laboratory**	Code:	**337661 (37)**
Total Lab Periods:	**24**	Batch Size:	**30**
Maximum Marks:	**40**	Minimum Marks:	**20**

Students have to solve at least four design problems out of the below mentioned topics

- Design of gears of a two stage gear-box (spur, helical or bevel)
- Design of a leaf spring for a given specification
- Design of chain drive for a given specification
- Design of belt drive for a given specification
- Design of rolling element bearing for a given specification
- Design of journal bearing for a given specification

B. Writing Computer programme for conventional design: Students are required to write computer program and validate it for the design of machine components done in theory subject

C. Mini Project: Each **s**tudent will be given a real life problem (as below) for the complete design of a subsystem/system using either manual calculation with the help of design handbook or through computer programme, if needed. This will be done as home assignment to be submitted at the end of the semester.

- Design the transmission system for an overhead crane assuming suitable data
- Design the transmission system for a lathe machine assuming suitable data
- Design the transmission system for an automobile assuming suitable data
- Design the transmission system for a shaper machine assuming suitable data
- Design the transmission system for a flour mill assuming suitable data
- Design the transmission system for a crusher machine assuming suitable data

The design must contain design of shafts, keys, couplings, clutch, pulleys/chain/gear drives, and bearings. The results must be plotted in the form of two dimensional drawings (manually/using software) both in component level and assembly level.

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Branch:	**Mechanical Engineering**	Semester:	**VI**
Subject:	**Internal Combustion Engine Laboratory**	Code:	**337662 (37)**
Total Lab Periods:	**24**	Batch Size:	**30**
Maximum Marks:	**40**	Minimum Marks:	**20**

List of Experiments (Minimum Six experiments and Four studies are to be performed by each student)

1. Study of IC Engine. (Engine components, material used and engine nomenclature)
2. Study of working of four stroke petrol engine and four stroke diesel engine with the help of cut section models.
3. Study of working of two stroke petrol and two stroke diesel engine with the help of cut section models.
4. Study of fuel supply system of a petrol engine (fuel pump and simple carburettor)
5. Study of complete caurburettor
6. Study of Petrol Injection System.
7. Study of fuel supply system of a Diesel engine (fuel pump and fuel injector)
8. Study of Ignition systems of an IC Engine (Battery and Magneto ignition system and Electronic ignition system).
9. Study of Lubrication system of an IC Engine (Mist, Splash and Pressure lubrication)
10. Study of cooling systems of an IC Engine (Air cooling and water cooling)
11. To conduct a performance test on diesel engine to draw heat balance sheet for given load and speed.
12. To determine friction power of diesel engine by Willan's line or fuel rate extrapolation method.
13. To conduct a performance test on the variable compression ratio engine and to draw the heat balance sheet for given compression ratio, speed and load and plot the performance curves.
14. To conduct a performance test on a four cylinder four stroke petrol engine and to draw the heat balance sheet and performance curves.
15. To calculate the indicated power, friction power and mechanical efficiency of four stroke four cylinder petrol engine at full load and rated speed by Morse test.
16. To draw the valve timing diagram of a four-stroke S.I. or C.I. Engine using experimental setup.
17. Analysis of engine exhaust gases using Orsat apparatus / gas analyzer.

LIST OF EQUIPMENTS/MACHINES REQUIRED

1. Model of Two & Four Stroke Petrol Engine
2. Model of Two & Four Stroke Diesel Engine
3. Single Cylinder Actual S.I.Engine in Cut Section
4. Single Cylinder Actual C.I..Engine in Cut Section
5. Four Stroke, Four-Cylinder Petrol Engine in Cut Section
6. Carburettors in Cut Section / Without Cut Section.
7. Model of Petrol Injection System
8. Bosch Fuel Pump in Cut Section
9. Nozzles in Cut Section
10. Diesel Injectors in Cut Section
11. Four Stroke Single-Cylinder Diesel Engine Test Rig
12. Variable Compression Ratio Engine Test Rig
13. Four Stroke Multi-Cylinder Petrol Engine Test Rig
14. Experimental Setup for Drawing Valve Timing Diagram Of Four Stroke S.I. or C.I. Engines.
15. Orsat Apparatus / Gas Analyzer for Engine Exhaust Gas Analysis.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	**Mechanical Engineering**	Semester:	**VI**
Subject:	**Production Management Laboratory**	Code:	**337663 (37)**
Total Lab Periods:	**24**	Batch Size:	**30**
Maximum Marks:	**40**	Minimum Marks:	**20**

The lab work is intended to have exposure and enhance the knowledge of students in production/ operation Management field acquired in the theory class. The basic approach followed is an information decision – making approach using various cases / small projects. These cases / projects deal with the kind of information that is present in the real world of the system and can also be solved using simulation based software. Simulation software provides excellent ease of learning and to rapidly achieve a high degree of self-sufficiency in model building.
Considering any one manufacturing product, the following practical problems are to be solved by the students for the Production Management laboratory.

1. Case study on Sales Forecasting.
2. Product Development process including its major operations, production process etc of a simple product.
3. Study of the Organization and their process layout.
4. Material Requirement Planning of any industrial product.
5. Study of Material handling systems in any manufacturing organization.
6. Analysis of Inventory control in an organization.
7. Production cost study with Break Even Analysis in a manufacturing organization.
8. Quality Analysis of a product carried out in a manufacturing organization.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	**Mechanical Engineering**	Semester:	**VI**
Subject:	**Heat & mass Transfer Laboratory**	Code:	**337664 (37)**
Total Lab Periods:	**24**	Batch Size:	**30**
Maximum Marks:	**40**	Minimum Marks:	**20**

List of Experiments (At least Ten experiments are to performed by each student):

1. To Determine Thermal Conductivity of Insulating Powders.
2. To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod).
3. To Measure the thermal Conductivity of Liquid.
4. To determine the transfer Rate & Temperature Distribution for a Pin Fin.
5. To Measure the Emmissivity of the Test plate Surface.
6. To Determine Stefan Boltzman Constant of Radiation Heat Transfer.
7. To Determine the Surface Heat Transfer Coefficient For Heated Vertical Cylinder in Natural Convection.
8. Determination of Heat Transfer Coefficient in Drop Wise & Film Wise condensation.
9. To Determine Critical Heat Flux in Saturated Pool Boiling.
10. To Study Performance of Simple Heat Pipes.
11. To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers.
12. To Find the Heat transfer Coefficient in Forced Convection in a tube.
13. To determine the total thermal conductivity and thermal resistance of the given compound resistance in series.
14. To find out the thermal conductivity of given slab material.
15. To determine the individual thermal conductivity of different lagging in a lagged pipe.
16. To study the rates of heat transfer for different materials and geometries
17. To understand the importance and validity of engineering assumptions through the lumped heat capacity method.
18. Testing and performance of different heat insulators.

List of Equipments/Machines required:

1. Thermal conductivity of insulating powder apparatus
2. Thermal conductivity of metal bar apparatus
3. Thermal conductivity of liquid apparatus
4. Transfer rate and temperature distribution for a pin fin apparatus
5. Emmissivity of the test plate surface apparatus
6. Stefen-Boltzman constant of radiation of heat transfer apparatus
7. Surface heat transfer coefficient for heated vertical cylinder in natural convection apparatus
8. Heat transfer coefficient in drop wise and film wise condensation apparatus
9. Critical heat flux in saturated pool boiling apparatus
10. Performance of different heat pipe apparatus
11. Heat transfer rate through heat exchanger apparatus
12. Heat transfer coefficient in forced convection of air in a tube apparatus
13. Heat transfer through composite wall apparatus
14. Thermal conductivity of insulating slab apparatus
15. Heat transfer through lagged pipe apparatus
16. Unsteady state heat transfer apparatus
17. Testing and performance test rig for heat insulators.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Name of Program:	**Bachelor of Engineering**		
Branch:	**Common to All Branches**	Semester:	**VI**
Subject:	**Managerial Skills**	Code:	**300665 (76)**
No. of Lectures:	**2/Week**	Tutorial Period:	**NIL**
Total Marks in ESE:	**NIL**	Marks in TA:	**40**

Minimum number of Class Tests to be conducted: **Two**

Objective:
The course is introduced to develop managerial skills tremendously and enrich the abilities to enable one to meet the challenges associated with different job levels. Managerial skills are essential for overall professional development of an individual apart from gaining technical knowledge in the subject.

Course Objectives
Upon completion of this course, the student shall be able
- To define and explain the concept of managerial, written and oral communication skill;
- To understand the leadership skill;
- To develop self-appraisal and understand distinction between leader and manager;
- To develop positive attitude and thinking; and
- To understand managerial functions and develop creativity.

UNIT I **Managerial Communication Skills:** Importance of Business Writing: writing business letters, memorandum, minutes, and reports- informal and formal, legal aspects of business communication, oral communication- presentation, conversation skills, negotiations, and listening skills, how to structure speech and presentation, body language.

UNIT II **Managerial skills - Leadership**: Characteristics of leader, how to develop leadership; ethics and values of leadership, leaders who make difference, conduct of meetings, small group communications and Brain storming, Decision making, How to make right decision, Conflicts and cooperation, Dissatisfaction: Making them productive.

UNIT III **Proactive Manager:** How to become the real you: The journey of self-discovery, the path of self-discovery, Assertiveness: A skill to develop, Hero or developer, Difference between manager and leader, Managerial skill check list, team development, How to teach and train, time management, Stress management, Self-assessment.

UNIT IV **Attitudinal Change:** Concept of attitude through example, benefits of right attitude, how to develop habit of positive thinking, what is fear? How to win it? How to win over failure? How to overcome criticism? How to become real you? How to Motivate? How to build up self confidence?

UNIT V **Creativity**: Creativity as a managerial skill, Trying to get a grip on creativity. Overview of Management Concepts: Function of Management: Planning, organizing, staffing, controlling.

Course Outcome
- The students will be able to develop formal and informal, negotiation, written and oral communication skill;
- The students will be able to develop manage groups, resolve conflicts and leadership skill and decision making qualities;
- The students will be able to develop self-appraisal, teaching, training and managing stress and time;
- The students will be able develop positive thinking, motivating team members and winning race; and
- The students will be able to develop creativity and fundamental management functions.

Text Books:

1. Basic Managerial Skills for all by E.H. Mc Grawth, Prentice Hall India Pvt Ltd,2006
2. Basic Employability Skills by P. B. Deshmukh, BSP Books Pvt. Ltd., Hyderabad, 2014

Reference Books:

1. How to develop a pleasing personality by Atul John Rego, Better yourself bools, Mumbai,2006
2. The powerful Personality by Dr. Ujjawal Patni & Dr. Pratap Deshmukh, Fusion Books, 2006

How to Success by Brian Adams, Better Yourself books, Mumbai, 1969

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	**Mechanical Engineering**	Semester:	**VI**
Subject:	**Industrial Hydraulics (Professional Elective – I)**	Code:	**337671(37)**
Total Theory Periods:	**40**	Total Tutorial Periods:	**10**
No. of class Tests to be conducted:	**2 (Minimum)**	No. of assignments to be submitted:	**2 (Minimum)**
ESE Duration:	**Three Hours**	Maximum Marks in ESE: **80**	Minimum Marks in ESE: **28**

Course Objective

- To Learn basic concepts and terminologies of hydraulics
- To understand construction and working of various hydraulic power system
- To understand the constructional details of pumps and actuators
- To understand various valves and auxiliaries & rectification of their problems.
- To understand the hydraulic circuits & develop Hydraulic Circuits
- To understand accumulators and intensifiers

COURSE OUTCOMES:

- Acquire knowledge and hands-on competence in applying the concepts of industrial hydraulics in the design and development of mechanical systems.
- Demonstrate creativeness in designing new systems components and processes in the field of engineering in general and mechanical engineering in particular.
- Identify, analysis, and solve mechanical engineering problems useful to the society.
- Work effectively with engineering and science teams as well as with multidisciplinary designs.

UNIT I **Fluidics:** Technology, Terminology, types of fluid logic elements, amplifiers, logic states, methods of obtaining input signals and power outputs, application of fluidics, third generation fluidics.

UNIT II **Hydraulic Fluid:** Types of hydraulic fluids, properties of fluid, selection of fluids, JIC/ISO symbols for hydraulic circuits.
Fluid Power System: Components, advantages, applications in the field of Machine Tools, material handling, presses, mobile and stationary machines, clamping & indexing devices etc., transmission of power at static and dynamic states.

UNIT III **Pumps:** Types, classification, principle and working of vane, gear, radial and axial plunger pumps, power and efficiency calculations, selection of pumps for hydraulic transmission.
Actuators: Linear and rotary actuators, hydraulic motor types & construction methods of control of acceleration, types of cylinder and mountings, calculation of piston velocity, thrust under static and dynamic application.

UNIT IV **Control of Fluid Power:** Principle, working types of the following valves, pressure control, direction control, flow control, relief valves, sequence values etc.

UNIT V **Hydraulic Circuits:** Meter in, meter out circuits, Pressure control for cylinders, Flow divider circuits, Circuit illustrating use of pressure reducer valves, sequence valve, counter balance valves, unloading valves with the use of electrical control, accumulators etc.
Accumulators and Intensifiers: Types, function, application, selection and design procedure.

TEXT BOOKS

1. Hydraulic Machines including fluidics – Dr. Jagdish Lal, Metropolitan Book Company, New Delhi
2. Introduction to Fluid Power – Sahastrabadhe, Nirali Prakashan, Pune

REFERENCE BOOKS

1. Industrial Hydraulics manual by Vickers
2. Industrial Hydraulics – Pipenger & Hicks, Mc Graw Hill Company, New York
3. Hydraulics Vol. 1 & 2 by Rexroth
4. Fluid Power – Goodwin

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	**Mechanical Engineering**	Semester:	**VI**
Subject:	**Control Engineering (Professional Elective – I)**	Code:	**337672(37)**
Total Theory Periods:	**40**	Total Tutorial Periods:	**10**
No. of class Tests to be conducted:	**2 (Minimum)**	No. of assignments to be submitted:	**2 (Minimum)**
ESE Duration:	**Three Hours**	Maximum Marks in ESE: **80**	Minimum Marks in ESE: **28**

Course Objectives:

- To understand the fundamental and types of control system.
- To know the basic theories of automatic control system.
- To acquire the knowledge of basic control system like hydraulic, pneumatic and electrical control system in detail.
- To understand the concept of logic controllers.
- To know the basic control system particular reference to mechanical system.

Course Outcomes:

- Acquire knowledge and hands-on competence in applying the concepts of control engineering in the design and development of mechanical systems.
- Demonstrate creativeness in designing new systems components and processes in the field of engineering in general and mechanical engineering in particular.
- Identify, analysis, and solve mechanical engineering problems useful to the society.
- Work effectively with engineering and science teams as well as with multidisciplinary designs.

UNIT I **BASIC CONTROL SYSTEM:** System differential equation of electrical, mechanical, thermal, hydraulic and electromechanical network, analogy.

UNIT II **THEORY OF AUTOMATIC CONTROL:** Concept of feedback referred to linear control systems in general, e.g. displacement and speed control, process control, definition and terminology, open loop and closed loop systems and its advantages. Block diagrams and single flow graph representation of a physical system, block diagram algebra, transfer function from a block diagram. Basic control actions and controllers on off. Proportional, derivative and integral controllers, steady – state analysis.

UNIT III **HYDRAULIC SYSTEM:** Characteristic of hydraulic components control valves, sources of hydraulic power hydraulic meters, pistons and transmission, elements of circuit design, Accumulation control circuit such as position control and speed control circuit.
Hydraulic Systems: Reciprocating Pump, pressure intensifier, cranes, ram, press, lift, coupling and hydraulic controls. Maintenance of hydraulic system: Fire Foam resistance oxidation and corrosion of hydraulic pipe sealing devices, Filters regulator, problems caused by gas in hydraulic circuit cooling of power pack

UNIT IV **PNEUMATIC SYSTEMS:** Pneumatic power supply, Amplifiers with different controlling actions, Pneumatic valves and cylinders, theory of four way and pilot valves.
ELECTRICAL SYSTEMS: Speed control of D.C. motors, Remote center positional serve mechanism (including effect of gearing between motor and load).

UNIT V **PROGRAMMABLE LOGIC CONTROLLERS:** Introduction, Micro PLC, Programming a PLC, Logic Functions, input & output Modules, PLC Processors, PLC Instructors, Documenting a PLC System, Timer & counter Instructions.
CONTROL COMPONENTS: Pneumatic relays, control mechanisms for liquid level, boiler feed control, pressure regulation, throttle valve, temperature regulations and industrial process regulation.

Text Books:

1. Modern Control Engineering, By Ogata K, Pearson Education
2. Control Systems Engineering By Nagrath & Gopal, New Age International Publishers
3 Process Control and Instrumentation / Technology – C.D. Johnson – Prentice Hall of India, New Delhi.

Reference Books:

1. Automatic Control System By Kuo, Benjamin.C, Prentice Hall
2. Control Systems Engineering By Nise, Norman S John wiley & Sons, New York
3. Control Systems Engineering By S K Bhattacharya , Pearson Education
4. Control Engineering By D.Ganesh Rao, K. Chennavenkatesh ,Pearson Education

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	**Mechanical Engineering/Mechatronics Engineering**	Semester:	**VI**
Subject:	**Engineering Economics (Professional Elective – I)**	Code:	**337673(37)**
Total Theory Periods:	**40**	Total Tutorial Periods:	**10**
No. of class Tests to be conducted:	**2 (Minimum)**	No. of assignments to be submitted:	**2 (Minimum)**
ESE Duration:	**Three Hours**	Maximum Marks in ESE: **80**	Minimum Marks in ESE: **28**

Course Objectives

- To prepare engineering student to analyze cost/revenue data and carry out economic analyses in the decision making process to justify or reject alternatives/projects on an economic basis.
- To prepare engineering students to function in the business and management side of professional engineering practice.

Course Outcome:

- Be able to make intelligent comparisons of project alternatives during the planning and implementation phases.
- Be able to perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives.
- Be able to perform and evaluate payback period and capitalized cost on one or more economic alternatives.
- Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.

UNIT I **Introduction & Scope:** Engineers and Economics, Utility of its study, Managerial Economics, Nature and scope, basic terms and concept of economics like goods, kinds of goods, utility, value and wealth. Theory of Demand and supply, Elasticity of demand. Meaning, Characteristics, Objectives of Firm, Managerial and behavioral theories of a firm.

UNIT II **Pricing and Market Competition:** Industrial Establishments, various types of industrial establishments, Sole traders, partnership, joint stock company,types of shares, financial goals of organization. Pricing Perspective approach: Pricing policy and price influencing factors, Basic data for price fixation. Market forms & Competition – Pure and perfect competition, monopoly, monopolistic competition, price determination under perfect and monopolistic competition.

UNIT III **Economy, Monetary & Fiscal Policy:** Balance of payments – money and monetary policy, fiscal policy, Inflation, measuring employment and unemployment. Credit policies Concept and measurement of national income. Working Capital, Factors deciding Working capital, Return on investment, Financial Planning.

UNIT IV **Cost and Costing Factors:** Cost Analysis – Types and Elements of cost, cost planning and control. Relationship between Average cost & Marginal cost, Short run and long run average cost curves.

UNIT V **Depreciation & Capital Budgeting:** Depreciation and its methods of calculation, marginal costing, break – even analysis, profit planning and forecasting, Capital budgeting, cost of capital, Appraising projects profitability.

TEXT BOOKS:

1. Managerial Economics – P.L. Mehta – S. Chand and sons
2. Economics Michael Parkin, Addison Wesley Longman Publication, International Edition.
3. Elementary Economics Theory – K.K. Dewett – S. Chand & Company

REFERENCE BOOKS:

1. Economics – Samuelson, Pauls & W.D. Nordhan – McGraw Hill
2. Advanced Cost Accounting – Nigam, Sharma – Himalaya Publishing House
3. Managerial Economics – Mote and Paul - TMH
4. Macro Economics for management Students – A. Nag - Macmillan India Ltd
5. Cost Accounting – Jain & Narang - Kalyan Publishers
6. Managerial Economics - G.S. Gupta – TMH
7. Engineering Economics – J.L. Riggs, D.D. Bedforth , Randhawa – TMH
8. Essentials of Managerial Economics – Reddy & Ganesh – Himalaya Publishing Hosue
9. Managerial Economics – Joel Dean - PHI

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	**Mechanical Engineering/Mechatronics Engineering**	Semester:	**VI**
Subject:	**Composite Materials (Professional Elective – I)**	Code:	**337674(37)**
Total Theory Periods:	**40**	Total Tutorial Periods:	**10**
No. of class Tests to be conducted:	**2 (Minimum)**	No. of assignments to be submitted:	**2 (Minimum)**
ESE Duration:	**Three Hours**	Maximum Marks in ESE: **80**	Minimum Marks in ESE: **28**

Course objective

- To be familiar with classification & characteristics of composite material and their application.
- To gain the knowledge about manufacturing methods, testing and environmental issue related with composite material.
- To train students to be able to design composite structures, select composite materials, conduct stress analyses of selected practical applications using laminated plate theories appropriate strength criteria.
- To be familiar with the properties and response of composite structures subjected to mechanical loading under static and cyclic conditions.

Course outcome

- Acquire knowledge and hands-on competence in applying the knowledge of composite materials in the design and development of mechanical systems.
- Demonstrate creativeness in designing new systems components in the field of engineering.
- Work effectively with engineering and science teams as well as with multidisciplinary designs.

UNIT I **Introduction to Composites:** Definition, classification/ types and characteristics of composite materials; Basic composite constituents – fiber and matrix; Properties of unidirectional long fiber and short fiber composites; Polymeric materials and polymeric composites; Honeycomb and Sandwich Composite Structure; Application areas of composites.

UNIT II **Manufacturing, Testing and Environmental Issues:** Moulding, pultrusion, filament winding, other advanced manufacturing techniques; Quality inspection and testing – uniaxial tension test, uniaxial compression test, shear test, fracture toughness testing of composites. Environmental Issues related with composite manufacturing and their applications.

UNIT III **Material Properties:** Orthotropic and Anisotropic materials; properties relating stress to strain, properties relating temperature to strain, properties relating moisture to strain, properties relating stress (or strain) to failure, Failure Criterion – Maximum Stress and Maximum Strain; Review of force tensors, stress tensors, strain tensors.

UNIT IV **Elastic Response Analysis:** Hooke's law for orthotropic and anisotropic materials; Linear Elasticity for Anisotropic Materials; Unidirectional composite laminates; Rotations of Stresses, Strains; Residual Stresses; Stress and environmental effects on composites behaviour.

UNIT V **Composite Laminates:** Thin-plate theory, classical lamination theory; Angle-ply and cross ply laminates; Static, dynamic and stability analysis for simple cases of composite plates; Interlaminar stress behaviour; Composite Joints; Design with Composites.

TEXT BOOKS

1. Agarwal, B. D., and Broutman L. J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York.
2. Mallick, P. K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", Marcel Dekker Inc.
3. Mukhopadhyay, M., "Mechanics of Composite Materials and Structures", University Press, India.

REFERENCE BOOKS

1. Halpin, J. C., "Primer on Composite Materials, Analysis", Techomic Publishing Co.
2. Mallick, P. K. and Newman, S., "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish.
3. Hyer, M. W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill, New York.
4. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition – 2007.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	**Mechanical Engineering**	Semester:	**VI**
Subject:	**Power Plant Engineering (Professional Elective – I)**	Code:	**337675(37)**
Total Theory Periods:	**40**	Total Tutorial Periods:	**10**
No. of class Tests to be conducted:	**2 (Minimum)**	No. of assignments to be submitted:	**2 (Minimum)**
ESE Duration:	**Three Hours**	Maximum Marks in ESE: **80**	Minimum Marks in ESE: **28**

Course Objectives

- To impart knowledge on sources of energy and types of power plants
- To understand construction and working of Steam Power Plants, Hydro Electric power station, diesel power station, and Nuclear Power Station.
- To impart knowledge about various performance characteristics and its analysis
- To impart knowledge about variable load problem
- To impart knowledge about terms and factors associated with power plant economics

Course Outcome:

- Demonstrate a basic understanding of various types of power plants.
- Acquire knowledge and hands-on competence in the design and development of mechanical systems associated with power plants.
- Compare different energy resources and choose the most appropriate based on local conditions
- Perform simple techno-economical assessments of energy resources
- Design power plant that meet specific energy demands, that are economically feasible and have a minimal impact on the environment

UNIT I **Elements of Power Plant:** General Sources of power, Importance of Central Power Stations, types of power stations – steam, nuclear, diesel and hydro – Elements of modern power stations (Steams only) brief layout and arrangement of elements and complements, sitting of different power stations, foundation. Elements of Electric power systems primary and secondary distribution substations (in brief)

UNIT II **Steam Power Plant:** Steam power plants, selection of working medium, Heat Balance in steam cycles, Heat rates, comparison of efficiencies gas loop, fuels and fuel handling. Equipments, fuel gas cleaning and ash handling. Air pre-heater, feed water pre-heaters, steam re-heaters, deaerators, feed water treatment, pumping and regulation water walls, modern developments in steam boilers, Important instrumentation and piping of gas and water loop. Factors to be controlled from maximum efficiency and variable output.

UNIT III **Hydro Electric power station** – Potential power with reference to rainfall and catchments area, Water storage, equipment used in hydro electric power stations. Characteristics of hydraulic turbines. Comparison of the factors governing the cost of hydro steam and diesel power stations.

Diesel power station – Suitability of diesel engines for bulk power, advantages and limitations of diesel, power stations, efficiency and heat balance.

UNIT IV **Nuclear Power Station:** Evolution of nuclear energy from atoms by fission and fusion. Chain reactions, fission materials, types of reactors, gas cooled, boiling water liquid, metal cooled and fast reactor, arrangements of various elements in a nuclear power station, stem cycles and boilers coolant heat exchangers, Reactor control, Reactor shielding and safety methods.

UNIT V **Variable load problems** – Idealized and realized load curves, effect of variable load on plant design and operation variable load operation and load dispatch.

Power station Economics – Source of income, cost of plant and production, elements of cost, depreciation and replacement theory of rates.

TEXT BOOKS:

1. Power Plant Engineering – P.K. Nag – Tata McGraw-Hill Pub. Com., New Delhi
2. A Course in Power Plant Engineering – S.C. Arora, S.Domkundwar – Dhanpat Rai & Co.

REFERENCE BOOKS:

1. Text Book of Power Plant Engineering – R.K. Rajput – Laxmi Publications
2. Power Plant Engineering – P.C. Sharma – S.K. Kataria & Sons
3. Power Plant Engineering – G.R. Nagpal – Khanna Publishers
4. Steam and gas turbine and power plant engineering- R. Yadav-CPH Allahabad

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	**Mechanical Engineering**	Semester:	**VI**
Subject:	**Maintenance & Reliability Engineering (Professional Elective – I)**	Code:	**337676(37)**
Total Theory Periods:	**40**	Total Tutorial Periods:	**10**
No. of class Tests to be conducted:	**2 (Minimum)**	No. of assignments to be submitted:	**2 (Minimum)**
ESE Duration:	**Three Hours**	Maximum Marks in ESE: **80**	Minimum Marks in ESE: **28**

Course Objectives

- To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To provide the concept of various types of maintenance system used in industries.
- To impart knowledge on reasons for failure and the corrective and preventive measure adopted to reduce them.
- To make the students to be familiar with the concept of reliability engineering
- To make the students to understand the various maintenance and logistics means or the execution of various services.
- To impart knowledge on creating various tools for maintainability of mechanical system.

Course outcome

Application of concepts of the course leads to the optimization of equipment, procedures, and departmental budgets to achieve better maintainability, reliability, and availability of equipment.

UNIT I **Maintenance Engineering:** Objective and functions, organization and administration, economics and maintenance policies. Types of maintenance systems-planned, unplanned, preventive, predictive, conditional monitoring, total predictive maintenance.

UNIT II **Failure Analysis:** Analysis of source, identification, classification and selectivity of failures, catastrophic, wearout and cumulative failures, failure rate Mortality distribution, statistical and reliability concept of failure analysis, equipment replacement policy.

UNIT III **Reliability Engineering:** Concept, bath tub curve, elements, Hazard Models- constant, linearly increasing, weibull. System Reliability - Series configuration, parallel configuration, mixed configuration, reliability improvement – Improvement of components, Redundancy – element, unit, standby, repairable and non repairable systems, reliability, availability, maintainability, MTBF, MTTR, reliability allocation for simple series system.

UNIT IV **Maintenance Management:** Maintenance planning, maintenance scheduling, work orders, work measurement, maintenance cost budgeting, store and spare control, maintenance planning and control techniques, Incentives for maintenance work.

UNIT V **Maintenance of Mechanical System:** Introduction, Bearings, Friction Clutches, Couplings, Fastening Devices, Chains, Gear Drives, Support Equipment, Cooling Towers.

TEXT BOOKS:

1. Maintenance Engineering & Management – R.C Mishra, K. Pathak – Prentice Hall of India, New Delhi
2. Maintenance Engineering – S. Shrivastava – S. Chand & Sons – New Delhi

REFERENCE BOOKS:

1. Industrial Maintenance – H.P. Garg – S. Chand Publication, New Delhi
2. Maintenance Planning & Control – A. Kelly – TMH, New Delhi
3. Concept in Reliability – LS. Srinath – Affiliated East-West Press, New Delhi

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	**Mechanical Engineering**	Semester:	**VI**
Subject:	**Computer Graphics (Professional Elective – I)**	Code:	**337677(37)**
Total Theory Periods:	**40**	Total Tutorial Periods:	**10**
No. of class Tests to be conducted:	**2 (Minimum)**	No. of assignments to be submitted:	**2 (Minimum)**
ESE Duration:	**Three Hours**	Maximum Marks in ESE: **80**	Minimum Marks in ESE: **28**

Note: All the algorithms are to be practiced in the computer Programming Laboratory and practice any computer aided drafting software.

Course Objective:

- To get familiar with Computer input and Output devices
- To introduce fundamental techniques and methods for two-dimensional and three-dimensional computer graphics.
- To recognize geometric and graphical elements of engineering design problems
- To understand the algorithms and models for geometric projections, transformations, coordinate systems, parametric curves, hidden surface determination, colour theory, texture mapping, shading and lighting.

Course Outcome:

- students will learn how to develop interactive programs that use effectively the graphics functionalities available in contemporary personal computers,
- students will learn the fundamental principles and technologies upon which these functionalities, and possibly their future evolutions, are based
- The skills for designing and implementing practical graphic solutions to challenging problems in different application domains.
- Proficiency in engineering design and ability to conduct an engineering project.
- Understanding of the business environment & Ability to manage information and documentation.
- Capacity for creativity and innovation & ability to demonstrate professional attitudes.

UNIT I **Input and Output Devices:** Keyboard, Mouse, Z mouse Trackball, Joysticks, Data Glove, Digitizers, Light pen, Touch Panels, Image scanners, Printers and Plotters. **Video Display device:** Refresh Cathode ray Tubes, Random Scan and Raster Scan monitors, Colour CRT Monitors, Flat panel display: LED and LCD Monitors & plasma display, Direct view Storage Tubes, Continuous Refresh and Storage display.

UNIT II **Output Characteristics:** Aspect ratio; Aliasing and Anti-aliasing. **Graphic primitives:** Points & Lines, Line drawing Algorithm, DDA and Bresenham's Algorithm. Circle Generation Algorithm: Midpoint circle algorithm. Ellipse Generation Algorithm: Mid-point ellipse algorithm. **Attributes of primitives:** Line style, Type, Width, Colour, Character Attributes, Area Filling: Inside-outside test; **Fill Algorithm:** Scan-Line Polygon Fill algorithm, Boundary Fill Algorithm - 4 and 8 connected area; Flood Fill Algorithm.

UNIT III **Analytical & Synthetic curve:** C0, C1 & C2 Continuity, Convex hull, Parametric & non Parametric representation of curves. **Analytic curves:** Parabola, Hyperbola, **Splines:** linear, quadratic, cubic, hermite, Bezier curves: single and multiple segments, Parametric forms of cubic splines, **Synthetic Curves:** Circle and ellipse drawing,

UNIT IV **2D Geometric Transformation**: **Window and View port:** Window definitions, View port definitions, Window and View port relationship; World co-ordinates; Normalized device co-ordinates and Homogenous co-ordinates. **Basic transformation**- Translation, Scaling, Rotation, Reflection, Twist, Matrix Representation, Composite Transformations. **3D Geometric Transformation**: Basic Transformations, 3D Display parallel & perspective projection.

UNIT V **Viewing:** Viewing, Device co-ordination system, Image co-ordination system, Viewing transformation. **Clipping:** Point clipping, Line clipping, Cohen- Sutherland clipping, Mid point clipping method, Sutherland and Hodgeman Clipping.

Text Books:

1. Computer Graphics-Donald hearn and M.Pauline Baker-Prentice Hall of India Pvt Ltd.
2. Introduction to Computer Graphics – N. Krishnamurhy - TMH Publication.

Reference Books:

1. Computer Graphics –Harrington S. – TMH Publication.
2. CAD-CAM Theory and Practice-Ibrahim Zeid- TMH Publication.
3. Xiang and Plastok - Schaum's Outlines Computer Graphics - TMH, 2nd Edition, 2002.
4. Rogers, "Procedural Elements for Computer Graphics – TMH