ARKA JAIN University
Jharkhand
Estd. Under Jharkhand State Private University Act

Syllabus of
DIPLOMA in Mechanical Engineering
Semester-I-II-III-IV-V-VI
for Batch (2020-24)

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ARKA JAIN University
Jharkhand

Syllabus of

Diploma in Mechanical Engineering

Semester-I

ARKAJAIN University, Jharkhand
School of Engineering & IT
Department of Engineering
Faculty – Diploma in Mechanical Engineering (DEME)
Scheme of Study (w.e.f Batch 2020-23)

SEMESTER –I

Sr. No.	Subject	Group	L-T-P	Credit
1	Mathematics-I	A & B	3-1-0	4
2	Communication Skills in English	A	3-0-0	3
	Fundamentals of Electrical & Electronics Engg.	B	3-1-0	4
3	Applied Physics	A	3-1-0	4
	Introduction to IT system	B	3-0-0	3
4	Applied Chemistry	A	3-1-0	4
	Engineering Mechanics	B	3-1-0	4
5	Environmental Science	B	2-0-0	0
	PRATICAL			
6.	Applied Physics Lab	A	0-0-1	1
	Fundamentals of electrical & electronics Engg. Lab	B	0-0-1	1
7.	Applied Chemistry Lab	A	0-0-1	1
	Introduction to IT system Lab	B	0-0-1	1
8.	Communication Skills in English Lab	A	0-0-1	1
	Engineering Mechanics Lab	B	0-0-1	1
9.	Engineering Workshop Practice	A	0-0-2	2
	Engineering Graphics	B	0-0-2	2
	Total	**A or B**	**23-5-10**	**36**

SEMESTER -II

Sr. No.	Subject	Group	L-T-P	Credit
1	Mathematics-II	A & B	3-1-0	4
2	Communication Skills in English	B	3-0-0	3
	Fundamentals of Electrical & Electronics Engg.	A	3-1-0	4
3	Applied Physics	B	3-1-0	4
	Introduction to IT system	A	3-0-0	3
4	Applied Chemistry	B	3-1-0	4
	Engineering Mechanics	A	3-1-0	4
5	Environmental Science	A	2-0-0	0
	PRATICAL			
6.	Applied Physics Lab	B	0-0-1	1
	Fundamentals of electrical & electronics Engg. Lab	A	0-0-1	1
7.	Applied Chemistry Lab	B	0-0-1	1
	Introduction to IT system Lab	A	0-0-1	1
8.	Communication Skills in English Lab	B	0-0-1	1
	Engineering Mechanics Lab	A	0-0-1	1
9.	Engineering Workshop Practice	B	0-0-2	2
	Engineering Graphics	A	0-0-2	2
	Total	**A or B**	**23-5-10**	**36**

SEMESTER –I (Group-A)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Communication Skills in English	HSC	3	3	100	70	20	5	5
2	Mathematics-I	BSC	4	4	100	70	20	5	5
3	Applied Physics	BSC	4	4	100	70	20	5	5
4	Applied Chemistry	BSC	4	4	100	70	20	5	5
	Practical								
5.	Engineering Workshop Practice	ESC	2	4	50	35	5	5	5
6.	Applied Physics Lab	BSC	1	2	50	35	5	5	5
7.	Applied Chemistry Lab	BSC	1	2	50	35	5	5	5
8.	Communication Skills in English Lab	HSC	1	2	50	35	5	5	5
	Total		**20**	**25**	**600**	**420**	**100**	**40**	**40**

SEMESTER I (Group-B)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Mathematics -I	BSC	4	4	100	70	20	5	5
2	Fundamentals of Electrical & Electronics Engg.	ESC	4	4	100	70	20	5	5
3	Introduction to IT system	ESC	3	3	100	70	20	5	5
4	Engineering Mechanics	ESC	4	4	100	70	20	5	5
5	Environmental Science	AC	0	2	50	35	10	2.5	2.5
	Practical								
6	Fundamentals of electrical & electronics Engg. Lab	ESC	1	2	50	35	5	5	5
7	Introduction to IT system Lab	ESC	1	2	50	35	5	5	5
8	Engineering Mechanics Lab	ESC	1	2	50	35	5	5	5
9	Engineering Graphics	ESC	2	4	50	35	5	5	5
	Total		**20**	**27**	**650**	**455**	**110**	**42.5**	**42.5**

SEMESTER II (Group-A)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Mathematics -II	BSC	4	4	100	70	20	5	5
2	Fundamentals of Electrical & Electronics Engg.	ESC	4	4	100	70	20	5	5
3	Introduction to IT system	ESC	3	3	100	70	20	5	5
4	Engineering Mechanics	ESC	4	4	100	70	20	5	5
5	Environmental Science	AC	0	2	50	35	10	2.5	2.5
	Practical								
6	Fundamentals of electrical & electronics Engg. Lab	ESC	1	2	50	35	5	5	5
7	Introduction to IT system Lab	ESC	1	2	50	35	5	5	5
8	Engineering Mechanics Lab	ESC	1	2	50	35	5	5	5
9	Engineering Graphics	ESC	2	4	50	35	5	5	5
	Total		**20**	**27**	**650**	**455**	**110**	**42.5**	**42.5**

SEMESTER –II(Group-B)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Communication Skills in English	HSC	3	3	100	70	20	5	5
2	Mathematics-II	BSC	4	4	100	70	20	5	5
3	Applied Physics	BSC	4	4	100	70	20	5	5
4	Applied Chemistry	BSC	4	4	100	70	20	5	5
	Practical								
5.	Engineering Workshop Practice	ESC	2	4	50	35	5	5	5
6.	Applied Physics Lab	BSC	1	2	50	35	5	5	5
7.	Applied Chemistry Lab	BSC	1	2	50	35	5	5	5
8.	Communication Skills in English Lab	HSC	1	2	50	35	5	5	5
	Total		**20**	**25**	**600**	**420**	**100**	**40**	**40**

SEMESTER-III

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Strength of Materials	PCC	4	4	100	70	20	5	5
2	Material Science & Engineering	PCC	3	3	100	70	20	5	5
3	Fluid Mechanics & Hydraulic Machinery	PCC	4	4	100	70	20	5	5
4	Manufacturing Technology-I	PCC	3	3	100	70	20	5	5
5	Thermal Engineering-I	PCC	3	3	100	70	20	5	5
	Practical								
6	Strength of Materials Lab	PCC	1	2	50	35	5	5	5
7	Fluid Mechanics & Hydraulic Machinery Lab	PCC	1	2	50	35	5	5	5
8	Manufacturing Technology-I Lab	PCC	1	2	50	35	5	5	5
9	Thermal Engineering- I Lab	PCC	1	2	50	35	5	5	5
10	Summer Internship-I(3-4 Weeks)	PROJ	2	0	50	35	15	0	0
	TOTAL		**23**	**25**	**750**	**525**	**135**	**45**	**45**

SEMESTER-IV

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Measurements & Metrology	PCC	3	3	100	70	20	5	5
2	Manufacturing Technology-II	PCC	4	4	100	70	20	5	5
3	Thermal Engineering - II	PCC	4	4	100	70	20	5	5
4	Elective-I Tool Engineering Heat Transfer Farm Equipment & Farm Machinery	PEC	3	3	100	70	20	5	5
5	Elective-II Computer Integrated Manufacturing Refrigeration & Air-conditioning Material Handling Systems	PEC	3	3	100	70	20	5	5
6	Essence of Indian Knowledge Tradition	AC	0	2	50	35	10	2.5	2.5
	Practical								
7	Measurements & Metrology Lab	PCC	1	2	50	35	5	5	5
8	Computer Aided Machine Drawing Practice Lab	PCC	1	2	50	35	5	5	5
9	Manufacturing Technology –II Lab	PCC	1	2	50	35	5	5	5
10	Thermal Engineering– II Lab	PCC	1	2	50	35	5	5	5
11	Minor Project	PROJ	2	4	50	35	15	0	0
	TOTAL		**23**	**31**	**800**	**560**	**145**	**47.5**	**47.5**

SEMESTER V

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory / Practical Exam	Mid Term Theory / Practical Exam	CIA*	Attendance
1	Advanced Manufacturing Processes	PCC	3	3	100	70	20	5	5
2	Theory of Machines & Mechanisms	PCC	3	3	100	70	20	5	5
3	Industrial Engineering & Management	PCC	3	3	100	70	20	5	5
4	Elective-III Computer Aided Design and Manufacturing Automobile Engineering Hybrid Vehicles	PEC	3	3	100	70	20	5	5
5	Elective-IV Industrial Robotics & Automation Power Plant Engineering Mechatronics	PEC	3	3	100	70	20	5	5
6	Open Elective-I Renewable Energy Technology Operation Research Internet of Thing	OEC	3	3	100	70	20	5	5
	PRACTICAL								
7	CAD/CAM Lab	PCC	1	2	100	70	20	5	5
8	Theory of Machines & Mechanisms Lab	PCC	1	2	50	35	5	5	5
9	Summer Internship-II(4-6 Weeks)	PROJ	3	0	100	70	30		
10	Major Project-I (Project to be carried over to next semester)	PROJ	1	2	50	35	15		
	TOTAL		**24**	**24**	**900**	**630**	**190**	**40**	**40**

SEMESTER VI

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory / Practical Exam	CIA*	Attendance
1	Design of Machine Elements	PCC	3	3	100	70	20	5	5
2	Production & Operations Management	PCC	3	3	100	70	20	5	5
3	Entrepreneurship and Start-ups	PROJ	4	4	100	70	20	5	5
4	Open Elective-II Sustainable Development Robotics Artificial Intelligent & Machine Learning	OEC	3	3	100	70	20	5	5
5	Open Elective-III Project Management Product Design Cyber Security Laws, Standards & IPR 3-D Printing	OEC	3	3	100	70	20	5	5
6	Indian Constitution	AC	0	2	50	35	10	2.5	2.5
	PRACTICAL								
7	Seminar	PROJ	1	2	50	35	15	0	0
8	Major Project-II	PROJ	3	0	100	70	30	0	0
	TOTAL		**20**	**20**	**700**	**490**	**155**	**27.5**	**27.5**

Distribution of Credit across 6 semesters:

Sl. No	Type of Paper	No. of Paper	Total Credit
1	Humanities and Social Sciences Courses **(HSC)**	2	4
2	Basic Science courses**(BSC)**	6	18
3	Engineering Science courses **(ESC)**	8	18
4	Professional core courses (**PCC)**	25	59
5	Professional Elective courses**(PEC)**	2	6
6	Open Electives Courses (**OEC)**	3	9
7	Project work, seminar and internship in industry or elsewhere**(PROJ)**	7	16
8	Audit Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]**(AC)**	3	(non-credit)
	Total	56	130

CIA – Continuous Internal Assessment – Based on Projects / Assignment during the semester

Note:

AICTE Activity Points to be earned by students admitted to Diploma program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 3 year Diploma program, is required to earn 75 activity points in addition to the total credits earned for the program. Students entering 3 years Diploma Program through lateral entry are required to earn 50 activity points in addition to the total credits earned for the program.
The activity points earned by the student shall be reflected on the students 6th Semester grade card.
The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled.
Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.
Incase student fail to earn the prescribed activity points, Sixth semester Grade Card shall be issued only after earning the required activity Points.
Students shall be eligible for the award of degree only after the release of the Six Semester grade card.

There are two groups (A & B) in semester 1 & 2. The Group division will be decided by The Dean SoE& IT before commencement of classes*

ARKAJAIN University, Jharkhand
School of Engineering & IT
Department of Engineering
Faculty – Diploma in Mechanical Engineering (DEME)
PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PROGRAM OUTCOMES

After completing this undergraduate program, a learner:

PO.1]. Basic knowledge: An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems

[PO.2]. Discipline knowledge: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.

[PO.3]. Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

[PO.4]. Engineering Tools: Apply appropriate technologies and tools with an understanding of the limitation.

[PO.5]. The engineer and society: Demonstrate knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering practice.

[PO.6]. Environment and sustainability: Understand the impact of the engineering solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development..

[PO.7]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

[PO.8]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse/multidisciplinary teams.

[PO.9]. Communication: An ability to communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.10]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological changes.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Maintenance selection and use of various equipment and machinery and instruments in mechanical processes.

[PSO.2]. Supervise and manage production process and demonstrate a knowledge of management and business practices, such as risk and change management, and understand their limitations.

PROGRAM ARTICULATION MATRIX

SEM	COURSECODE	PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
I	Communication Skills in English –DIP11149			1	1		1			1	1		
	Mathematics-I –DIP11001	1	1	1	2	1		1			1		
	Applied Physics –DIP11147	2	1	3	2								
	Applied Chemistry –DIP11145	1	1			1	1				1		1
	Engineering Workshop Practice –DIP11151	1	1	1	1		1			1			
	Applied Physics Lab –DIP11148	1	1	3	2		1						
	Applied Chemistry Lab –DIP11146			1	1		1					1	
	Communication Skills in English Lab –DIP11150	1		1	1		1	1	1	1			
II	Mathematics -II –DIP12008	1	1	1	1	1						1	
	Fundamentals of Electrical & Electronics Engg.-DIP12278	1	1	1	2	1					1	1	1
	Introduction to IT system –DIP12157	1		2	3		1			1	2		
	Engineering Mechanics –DIP12153	3	3		3						3		3
	Environmental Science –DIP12155					2	3				2		
	Fundamentals of electrical & electronics Engg. Lab –DIP12156	1	2	2	3	2		2					
	Introduction to IT system Lab –DIP12279	1		2	3		1			1	2	1	
	Engineering Mechanics Lab –DIP12154	1	2	2	3	2		2					
	Engineering Graphics DIP12152	2	1		1							2	2
	Strength of Materials-DIP13100	3	3	3								2	2
	Material Science & Engineering –DIP13174	3	2	3	3							2	2
	Fluid Mechanics & Hydraulic Machinery –DIP13280	1	3	3								2	2

III	Manufacturing Technology-I DIP14110	1	3	2	2	2						2	2
	Thermal Engineering-I –DIP13179	1	3	2	2							2	2
	Strength of Materials Lab-DIP13104	1	3	3	3							3	2
	Fluid Mechanics & Hydraulic Machinery lab-DIP13281	1	3	3	2							3	3
	Manufacturing Technology-I Lab-DIP14113		2	3	3							3	2
	Thermal Engineering Lab-I-DIP13178	1	2	3	2							2	2
	Summer Internship-I(3-4 Weeks)-DIP13177												
IV	Measurements & Metrology –DIP14201	1	3	3	3		1	1	2	2	2	2	2
	Manufacturing Technology-II-DIP16124		3	3	3				2		2	3	3
	Thermal Engineering –II-DIP14208		3	3	1						2	2	2
	Elective-I Tool Engineering-DIP15118		3	3	3				1		3	3	3
	Heat Transfer-DIP14191		3	3	3				1		3	3	3
	Farm Equipment & Farm Machinery-DIP14190		3	3	3	2	2		1		3	3	3
	Elective-II Computer Integrated Manufacturing-DIP14185	2	3	3	3					1	2	1	3
	Refrigeration & Air-conditioning-DIP16142		3	2	3						2	2	2
	Material Handling Systems-DIP16141	2	3	3	3				1		3	3	3
	Essence of Indian Knowledge Tradition-DIP13172						2	1			1		
	Measurements & Metrology Lab –DIP14201	2	3	3	3						2	3	1
	Computer Aided Machine Drawing Practice –DIP14184		3	3	3				1	2	2	2	3
	Manufacturing Technology Lab-II –DIP16127	2	3	3	3				2		3	3	3
	Thermal Engineering Lab –II-DIP14209		3	3	3		2				2	3	2
	Minor Project-DIP14203												
	Advanced Manufacturing Processes –DIP15115	3	3	3	3						3	3	3
	Theory of Machines & Mechanisms –DIP14107	3	3	3	3							3	
	Industrial Engineering & Management-DIP15231	3	3	3					2	3		3	3
	Elective-III												
	Computer Aided Design and Manufacturing-DIP15219	3	3	3	3						3	2	2
	Automobile Engineering-DIP15138	3	3	3	3						3	2	1
	Hybrid Vehicles-DIP15229	3	3	2								3	2
	Elective-IV	3	3								3		

V	Industrial Robotics & Automation-DIP15232												
	Power Plant Engineering-DIP15139	3	3	3							3	3	3
	Mechatronics-DIP15140	3	3	3									1
	Open Elective-I Renewable Energy Technology-DIP15251	3	3	3								3	3
	Operation Research-DIP16256	3		3					2	2	3	2	2
	Internet of Thing-DIP15234							2		2			
	CAD/CAM Lab –DIP15217	3	3	3							3		
	Theory of Machines &Mechanisms Lab –DIP15246	3	3	3	3								
	Summer Internship-II(4-6 Weeks)-DIP15244												
	Major Project-I (Project to be carried over to next semester)-DIP15236												
VI	Design of Machine Elements –DIP16122	3	3	3	3	3						3	3
	Production & Operations Management-DIP16271	3	3	3	3	3						3	3
	Entrepreneurship and Start-ups –DIP16265	3	3	3	3	3						3	3
	Open Elective-II Sustainable Development-DIP16267	3	3		2	2	3	3		2		3	1
	Robotics-DIP16273	3	3	3	3	3						3	3
	Artificial Intelligent & Machine Learning-DIP15215	3	3	3	3	3						3	3
	Open Elective-III Project Management-DIP16257	3	3		2	2	3	3		2		3	1
	Product Design-DIP16270	3	3		2	2	3	2	2	2		3	2
	Cyber Security Laws, Standards & IPR-DIP16262	3	3		2	2	3	2		2		3	1
	3-D Printing-DIP16259	3	3		2	2	3	3		2		3	1
	Indian Constitution-DIP16266					3	2	3		2			
	Seminar-DIP16274												
	Major Project-II-DIP16267												
AVERAGE													

Subject: Mathematics-I

Code: DIP11001

4 Credits | Semester 1

A. Introduction:

- To develop logical understanding, mathematical skill of the subject.
- To make aware students about importance and relation between mathematics and engineering
- To gives sufficient basic concepts for future applications in different subjects

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Rememberingthe concept of Vectors and use of vectors in mathematics

[CO2] Understand, predict and optimize engineering systems.

[CO3] Analyze vectors in geometrically and algebraically.

[CO4] Analyzing about different forms of the equation of straight line and curves

[C05] Evaluating why mathematical thinking is valuable in daily life..

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

TRIGONOMETRY: Concept of angles, measurement of angles in degrees, grades and radians and their conversions,). T-Ratios of Allied angles (without proof), Sum, difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versaT- Ratios of multiple angles, sub-multiple angles (2A, 3A, A/2). Graphs of sin x, cos x, tan x and e^x.

ALGEBRA: Complex Numbers: Definition, real and imaginary parts of a Complex number, polar and Cartesian, representation of a complex number and its conversion from one form to other, conjugate of a complex number, modulus and amplitude of a complex number.
Addition, Subtraction, Multiplication Division of a complex number. De-movier's theorem and ., its applicationPartial fractions: Definition of polynomial fraction proper & improper fractions and definition of partial fractions. To resolve proper fraction into partial fraction with denominator containing non-repeated linear factors, repeated linear factors and irreducible non-repeated quadratic factors. To resolve improper fraction into partial fraction.
Permutations and Combinations: Fundamental rules of counting, Value of nPr
Value of nCr.**Binomial theorem:** Binomial theorem (without proof) for positive integral index (expansion and general form); binomial theorem for any index (expansion without proof) first and second binomial approximation with applications to engineering problems

CO-ORDINATE GEOMETRY: Straight lines: Different forms of equations of straight lines: $y = mx + c$, $y - y_1 = m(x - x_1)$,$y - y_1 = \left(\frac{y_2 - y_1}{x_2 - x_1}\right)(x - x_1)$. General equation of a line$ax + by + c = o$ (graphical representation and statements) and problems on above equations. Equation of lines through a point and parallel or perpendicular to a given line. Problems.**Conic Section:** Definition of conic section. Definition of axis, vertex, eccentricity, focus and length of latus rectum. Equation and Geometrical representation of parabolaEquations of ellipse and hyperbola. Finding axes, vertices, eccentricity, foci and length of lattice rectum of conics. Problems on finding the above said equations with direct substitutionGeneral equation of a circle and its characteristics. To find the equation of a circle, giveni. Centre and radius,ii. Three points lying on it andiii. Coordinates of ends of a diameter;

VECTORS: Definition of vector. Representation of vector as a directed line segment. Magnitude of a vector. Types of vectors. Position vectorExpression of vector by means of position vectors. Addition and subtraction of vectors in terms of line segment. Vector in plane and vector in a space in terms of unit vector i, j and k respectivelyProduct of vectors. Scalar product and vector product of two vectors. Geometrical meaning of scalar and vector product. Applications of dot (scalar) and cross (vector) productsProjection of a vector on another vector. Area of parallelogram and area of triangle.

E. TEXT BOOKS

T1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 40th Edition2007.

F. REFERENCE BOOKS

R2. G. B. Thomas, R. L. Finney, Calculus and Analytic Geometry, Addison Wesley, 9th Edition, 1995.
R3. NCERT Mathematics Text books of class XI and XII.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES						CORRELATION WITH PROGRAM SPECIFIC OUTCOMES					
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Remembering the concept of Vectors and use of vectors in mathematics	2		1									
[CO2]	Understand, predict and optimize engineering systems.		1		1								
[CO3]	Analyze vectors in geometrically and algebraically				1	1							
[CO4]	Analyzing about different forms of the equation of straight line and curves							1			1		
[CO5]	Evaluating why mathematical thinking is valuable in daily life									1	1		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Communication Skills in English

Code: DIP11149

Credit - 3 | Semester 1

A. Introduction:

- To introduce students to the understanding of English language and its usage in their field of engineering. It helps the students to enhance their ability to read, write and speak English well.

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Learn the different forms & type of communication.
[CO2] Learn the writing formats and letter story.
[CO3] Learn the Reading comprehension
[CO4] Learn Grammar and Vocabulary
[CO5] Learn Soft skills and Professional Excellence.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

COMMUNICATION: THEORY AND PRACTICE: Basics of communication: Introduction, meaning and definition, process of communication etc.Types of communication: formal and informal, verbal, non-verbal and written Barriers to effective communication**7** Cs for effective communication (considerate, concrete, concise, clear, complete, correct, and courteous).Art of Effective communicationchoosing words, Voice, Modulation, Clarity, Time, Simplification of words, Technical Communication.

PROFESSIONAL WRITING: The art of precise writing, Letters: - business and personnel

READING COMPREHENSION BASED ON FOLLOWING TEXTS: Malgudi days: r.kNarayan, The room on the roof; ruskin bond, The gift of the magi by o. Henry, Night of the scorpion: nizzimezekeil, Stopping by woods on a snowy evening: robert frost

VOCABULARY AND GRAMMAR: Vocabulary of commonly used, Glossary of administrative terms (English and Hindi), One-word substitution, Idioms and phrases etcnelsParts of speech, active and passive voice, tenses etc., Punctuation, subject of agreement , preposition , articles

SOFT SKILLS FOR PROFESSIONAL EXCELLENCE: Introduction: Soft Skills and Hard Skills, Importance of soft skills.Life skills: Self-awareness and Self-analysis, adaptability, resilience, emotional intelligence etc., Applying soft skills across cultures, Case Studies

E. TEXT BOOKS

T1. J.D.O'Connor. Better English Pronunciation. Cambridge: Cambridge University Press, 1980.

T2. Lindley Murray. An English Grammar: Comprehending Principles and Rules. London: Wilson and Sons, 1908.

T3. Kulbhushan Kumar, Effective Communication Skills, Khanna Publishing House, New Delhi (Revised Edition 2018).

T4. Margaret M. Maison. Examine your English. Orient Longman: New Delhi, 1964.

F. REFERENCE BOOKS

R1. M. Ashraf Rizvi. Effective Technical Communication. Mc-Graw Hill: Delhi, 2002.
R2. John Nielson. Effective Communication Skills. Xlibris, 2008.
R3. Oxford Dictionary
R4. Roget's Thesaurus of English Words and Phrases
R5. Collin's English Dictionary
R6. High school english grammar and composition- Wren and Martin (s.chand&co.)
R7. The king's grammar- Sanjay kumarsinha (s.chand& co.)

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES						CORRELATION WITH PROGRAM SPECIFIC OUTCOMES					
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Learn the different forms & type of communication						2			2			
[CO2]	Learn the writing formats and letter story.			2									
[CO3]	Learn the Reading comprehension								2		2		
[CO4]	Learn Grammar and Vocabulary			2	2								
[CO5]	Learn Soft skills and Professional Excellence.								2				

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Applied Physics

Code:DIP11147

Credits- 4 | Semester 1

A. Introduction:

- Identify, formulate, and solve engineering problems by applying principles of physics.
- To give an understanding of this world both by observation and by prediction of the way in which objects behave.
- Acquire and apply new knowledge as needed, using appropriate learning strategies

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Represent physical quantities as scalar and vectors and solve real life relevant problems.

[CO2] Define scientific work, energy and power and their units. Drive relationships for work, energy and power and solve related problems.

[CO3] Compare and relate physical properties associated with linear motion and rotational motion and apply conservation of angular momentum principle to known problems.

[CO4] Explain the phenomenon of surface tension, viscosity, fluid motion & Hooke's law, which helps to illustrate the properties of matter.

[CO5] Apply the basic knowledge of semiconductors to illustrate the functioning of simple electronic devices &nano technology.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

A. SYLLABUS

FORCE AND MOTION: Units and Measurements: Physical quantities; Definition of unit, types of unit (fundamental and derived) SI units: Definition, Basic and supplementary units, advantages. Scalars and Vectors: Scalar and Vector quantities – examples, representation of vector, types of vectors. Addition and Subtraction of Vectors, Triangle and Parallelogram law (Statement only), Lami'stheorems, Scalar and Vector Product, Resolution of a Vector and its application to inclined plane and lawn roller.Force: Definition of Force, Momentum, Statement and derivation of conservation of linear momentum, its applications such as recoil of gun,

rockets, Impulse and its applications.Circular motion, definition of angular displacement, angular velocity, angular acceleration, frequency, time period, Relation between linear and angular velocity, linear acceleration and angular acceleration (related numerical), Centripetal and Centrifugal forces with live examples, Expression and applications such as banking of roads and bending of cyclist.

WORK, ENERGY AND HEAT: Work Energy & Power: Concept and units, examples of zero work, positive work and negative work .Energy and its units, kinetic energy, gravitational potential energy with examples and derivations, mechanical energy, conservation of mechanical energy for freely falling bodies, transformation of energy (examples). Power and its units, power and work relationship, **Numerical on work , potential and kinetic energy),** calculation of power (numerical problems), **Concept of heat & temperature**: Definitions of heat and temperature with S.I units, definition of Specific heat of substance with S I unit, equation for specific heat of a substance (no derivation).scales of temperature and their relationship, Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansionsand relation amongst them,**Transmission of heat:** Definitions of conduction, convection and radiation with examples, definition of thermal conductivity, derivation of co-efficient of thermal conductivity (K) and its S.I unit. Applications of conduction, convection and radiation, simple problems on K.**Thermodynamics**: Definition of thermodynamics, Laws of thermodynamics: Zeroth law, I^{st}law and II^{nd}law(only statement), types of thermodynamics process: isothermal process, adiabatic process.

ANGULAR MOTION AND WAVE MOTION: Angular and Rotational Motion: Definition of angular displacement, angular velocity and angular acceleration, relation between linear velocity and angular velocity. Translational and rotational motions with examples, Definition of torque and angular momentum and their examples, Conservation of angular momentum (quantitative) and its applications, **Wave motion**: Transverse and longitudinal waves with examples, definitions of wave velocity, frequency and wave length and their relationship, Sound and light waves and their properties, wave equation (y =r sin t) amplitude, phase, phase difference, principle of superposition of waves and beat formation, **Simple Harmonic Motion:** Definition of periodic motion with example, definition of Simple Harmonic Motion, SHM as a projection of uniform circular motion on any diameter , equation of SHM, derivation of displacement, velocity and acceleration of a body executing SHM.Free vibrations, Forced vibration, Damped vibrations and Un-damped vibrations with examples. **Simple problems**.

PROPERTIES OF MATTER: Properties of solids: Elasticity: definition of stress and strain, moduli of elasticity, Hooke's law, significance of stress-strain curve.**Properties of liquids**:

Pressure: definition, units, atmospheric pressure, gauge pressure, absolute pressure, Fortin's Barometer and its application**Hydrodynamics**: Fluid motion, stream line and turbulent flow, Reynold's number Equation of continuity, Bernoulli's Theorem (only formula and numericals) and its applications.**Surface Tension**: Concept, units, cohesive and adhesive forces, angle of contact, Ascent Formula (No derivation), applications of surface tension, effect of temperature and impurity on surface tension.**Viscosity**: viscosity and coefficient of viscosity, Terminal velocity, Stoke's law and effect of temperature on viscosity, application in hydraulic systems. Simple problems.

SEMICONDUCTOR & MODERN PHYSICS: Semiconductor: Energy bands in solids, Types of materials (insulator, semi-conductor, conductor), intrinsic and extrinsic semiconductors, p-n junction, junction diode and V-I characteristics, types of junction diodes. Diode as rectifier – half wave and full wave rectifier (centre taped). Transistor; description and three terminals, Types- PNP and NPN, some electronic applications (list only). Photocells, Solar cells; working principle and engineering applications. **Lasers**: Principle and Working of Laser, properties of Laser, Types of lasers; Ruby, He-Ne,characteristics and applications. **Optical fibre**: Introduction, Total internal reflection, critical angel acceptance angle, Structure of optical fiber, Numerical Aperture, applications in communication system (Numerical on critical angel , numerical aperture) **Nano-Technology**: Definition of Nanoscale, nanometer &nano particle application of Nano-Technology-electronics, automobiles, medical, textile, cosmetics, environmental, spaces and defence, advantages and dis-advantages of nano-Technology. **Nonconventional source of energy :**Introduction – Non Renewable and renewable (Alternate), energy sources, Examples –Solar Energy, Wind Energy, Tidal Energy, Geo-Thermal Energy and Bio-Mass, Advantages and disadvantages of renewable energy.

E. TEXT BOOKS

T1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi
T2. Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi
T3. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi

F. REFERENCE BOOKS

R1. Applied Physics, Vol. Vol. II and TTTI Publications, Tata McGraw Hill, Delhi, I
R2. Concepts in Physics by HC Verma, Vol. I & II, BhartiBhawan Ltd. New Delhi
R3. Modern approach to Applied Physics-I and II, AS Vasudeva, Modern Publishers.
R4. A Textbook of Optics, N Subramanyam, BrijLal, MN Avahanulu, S Chand and Company Ltd.

R5. Introduction to Fiber Optics, AjoyGhatak and K Thyagarajan, Cambridge University Press India Pvt. Ltd, New Delhi.
R6. Nanoscience and Nanotechnology, KK Choudhary, Narosa Publishing House, Pvt. Ltd. New Delhi.
R7. Nanotechnology: Importance and Applications, M.H. Fulekar, IK International Publishing House Pvt. Ltd, New Delhi.
R8. E-books/e-tools/ learning physics software/websites etc.
R9. Principle of physics for class XI and XII by V.K.Mehata and Rohit Mehta, as per Karnataka state PUC syllabus S.Chand and Company, New Delhi
R10. Principle of physics by P.V.NaikPHI Learning Pvt. Ltd. New Delhi

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES						CORRELATION WITH PROGRAM SPECIFIC OUTCOMES					
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Represent physical quantities as scalar and vectors and solve real life relevant problems.	3		2									
[CO2]	Define scientific work, energy and power and their units. Drive relationships for work, energy and power and solve related problems.			2									
[CO3]	Compare and relate physical properties associated with linear motion and rotational motion and apply conservation of angular momentum principle to known problems.			2	3								
[CO4]	Explain the phenomenon of surface tension, viscosity, fluid motion & Hooke's law, which helps to illustrate the properties of matter.				2								
[CO5]	Apply the basic knowledge of semiconductors to illustrate the functioning of simple electronic devices & Nano technology.	2	3										

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Applied Chemistry

Code: DIP11145

Credits- 4 | Semester I

A. Introduction:

- There are numerous number materials are used in fabricating and manufacturing devices for the comfort of life.
- The selection, characterization and suitability assessment of natural raw materials essentially requires principles and concepts of Applied Chemistry for technicians.

B. Course Outcomes: At the end of the course, students will be able

[CO1] Understand the classification and general properties of engineering materials such as metal, alloys, glasses, cement, refractory and composite materials using knowledge of chemical bonding.

[CO2] Understand and assess the suitability of water source for domestic and industrial application, effluents and minimize water pollution.

[CO3] Qualitatively analyze the engineering materials and understand their properties and applications.

[CO4] Choose fuel and lubricants suitable for economical industrial processing to obtain eco-friendly finished products

[CO5] Ascertain construction, mechanism efficiency of electrochemical cells, solar cell fuel cells. Understand corrosion and develop economical prevention techniques.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

ATOMIC STRUCTURE, CHEMICAL BONDING AND SOLUTIONS: Rutherford model of atom, Bohr's theory (expression of energy and radius to be omitted), and hydrogen spectrum explanation based on Bohr's model of atom, Heisenberg uncertainty principleQuantum numbers – orbital concept. Shapes of s,p and d orbitals, Pauli's exclusion principle, Hund's rule of maximum multiplicity Aufbau rule, electronic configurationConcept of chemical bonding – cause of chemical bonding, types of bonds: ionic bonding (NaCl example), covalent bond (H2,

F2, HF hybridization in BeCl2, BF3, CH4, NH3, H2O) Coordination bond in NH4+, and anomalous properties of NH3, H2O due to hydrogen bonding, and metallic bonding.

WATER: Graphical presentation of water distribution on Earth (pie or bar diagram). Classification of soft and hard water based on soap test, salts causing water hardness, unit of hardness and simple numerical on water hardness.Cause of poor lathering of soap in hard water, problems caused by the use of hard water Iboiler (scale and sludge, foaming and priming, corrosion etc) Quantitative measurement of water hardness by ETDA method, total dissolved solids (TDS) alkalinity estimation. Municipal water treatment BOD &CODEnlist Indian standard specification of drinking water (collect data and understand standards)

ENGINEERING MATERIALS: Natural occurrence of metals – minerals, ores of iron, aluminum and copper, gangue (matrix), flux, slag, metallurgy – brief account of general principles of metallurgy.Extraction of - iron from hematite ore using blast furnace, aluminumfrom bauxite along with reactions. Alloys – definition, purposes of alloying, ferrous alloys and non-ferrous with suitable examples, properties and applications.Port land cement and hardening, Glasses Refractory and Composite materials.Polymers – monomer, homo and co polymers, degree of polymerization, simple reactions involved in preparation and their application of thermoplastics and thermosetting plastics (usingPVC, PS, PTFE, nylon – 6, nylon – 66, Bakelite only), rubber and vulcanization of rubber

CHEMISTRY OF FUELS AND LUBRICANTS: Definition of fuel and combustion of fuel, classification of fuels, calorific values (HCV and LCV)Proximate analysis of coal solid fuel petrol and diesel - fuel rating (octane and cetane numbers),Chemical composition, calorific values and applications of LPG, CNG, water gas, coal gas, producer gas and biogas.Lubrication – function and characteristic properties of good lubricant, classification with examples, lubrication mechanism –, physical properties (viscosity and viscosity index, oiliness, flash and fire point, could and pour point only) and chemical properties (coke number, total acid number saponification value) of lubricants

ELECTRO CHEMISTRY: Electronic concept of oxidation, reduction and redox reactions.Definition of terms: electrolytes, non-electrolytes with suitable examples, Faradays laws of electrolysis and simple numerical problems.Industrial Application of Electrolysis – Electrometallurgy Application of Redox reactions in electrochemical cells –Primary cells – dry cell,Secondary cell - commercially used lead storage battery, fuel and Solar cells.Introduction to Corrosion of metals – definition, types of corrosion (chemical and electrochemical), H_2 liberation andO_2 absorption mechanism of electrochemical corrosion, factors affecting rate of corrosion.Internal corrosion preventive measures – Purification, alloying and heat treatment and external corrosion preventive measures: metal (anodic, cathodic) coatings.

E. TEXT BOOKS

T1. Text Book of Chemistry for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi, 2017-18.
T2. Agarwal, &Shikha, Engineering Chemistry, Cambridge University Press; New Delhi, 2015.
T3. Agnihotri, Rajesh, Chemistry for Engineers, Wiley India Pvt.Ltd., 2014.
T4. Jain & Jain, Engineering Chemistry, DhanpatRai and Sons; New Delhi, 2015.

F. REFERENCE BOOKS

R1. C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.
R2. Dara, S. S. &Dr.S.S. Umare, Engineering Chemistry, S.Chand. Publication, New Delhi, New Delhi, 2015.
R3. Dr. Vairam, S., Engineering Chemistry, Wiley India Pvt.Ltd., New Delhi, 2013.
R4. Dr. G. H. Hugar& Prof A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. I and Vol. II NITTTR, Chandigarh, Publications, 2013-14.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES						CORRELATION WITH PROGRAM SPECIFIC OUTCOMES					
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Understand the classification and general properties of engineering materials such as metal, alloys, glasses, cement, refractory and composite materials using knowledge of chemical bonding.		**2**				**1**						
[CO2]	Understand and assess the suitability of water source for domestic and industrial application, effluents and minimize water pollution.	**2**											**1**
[CO3]	Qualitatively analyze the engineering materials and understand their properties and applications				**1**	**1**						**1**	
[CO4]	Choose fuel and lubricants suitable for economical industrial processing to obtain eco-friendly finished products				**2**			**1**					**1**
[CO5]	Ascertain construction, mechanism efficiency of electrochemical cells, solar cell fuel cells. Understand corrosion and develop economical prevention techniques.			**2**					**1**				

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

ENGINEERING WORKSHOP PRACTICE

Code: DIP11151
Credits 2 | Semester I

A. Introduction:

- To understand basic engineering processes for manufacturing and assembly
- To understand, identify, select and use various marking, measuring, and holding, striking and cutting tools and equipment's
- To understand and interpret job drawings, produce jobs, and inspect the job for specified dimension.

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Acquire skills in basic engineering practice to identify, select and use various marking, measuring, and holding, striking and cutting tools &equipment's and machines
[CO2] Understand job drawing and complete jobs as per specifications in allotted time
[CO3] Inspect the job for the desired dimensions and shape
[CO4] Operate, control different machines and equipment's adopting safety practices

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

FITTING SHOP: Introduction Of Workshop Tools & Measuring InstrumentFitting: - Demonstration of different fitting tools, safety practice and general guidelines. Cutting and Filing. Filing, Measurement and Finishing etc Practice: T-fitting , V-Fitting etc

CARPENTRY SHOP: Demonstration of power tools and equipment for carpentry, safety practices and general guidelines. Carpentry: Demonstration of different wood working tools / machines. Demonstration of Different Wood Working Processes Like Plaining Marking ,Chiseling ,Grooving ,Turning of Wood etc Practice: - T-Lap joint, Dovetail joint etc

WELDING SHOP: Demonstration of tools and equipment for welding, safety practices and general guidelines. Demonstration of different welding tools / machines. Demonstration on Arc Welding, Gas Welding, MIG, MAG welding, gas cutting and rebuilding of broken parts with welding Practice : Butt , lap joint etc.

PLUMBING SHOP: Demonstration – plumbing tools, symbols and joints.Joining GI pipes by threading, PVC pipes by gluing and cementingPractice :- To Make Internal & External Thread

MACHINE SHOP: Demonstration of tools and equipment for Machine, safety practices and general guidelines. Demonstration of all machine like Lathe Machine, Drill machine, Milling Machine, Shaper machine etc. Practice :- To make Step Turning , Tapper Turning, Turning, Facing etc.

E. TEXT BOOKS

T1. Workshop Technology Vol-I,II,IIIHajraChoudry., Media Promotors and Publishers P Ltd.

T2.Manufacturing Technology vol 1 by P.N. RaoMc.Grow Hill.

F. REFERENCE BOOKS

R1. Workshop technology by R.S. Raghuwanshi.Dhanpat Ray & co

R2. Workshop technology by R.S. Khurmi&J.K.GuptaS.Chand co.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT .	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Acquire skills in basic engineering practice to identify, select and use various marking, measuring, and holding, striking and cutting tools & equipment's and machines	2								2			
[CO2]	Understand job drawing and complete jobs as per specifications in allotted time						2			2			
[CO3]	Inspect the job for the desired dimensions and shape		2										
[CO4]	Operate, control different machines and equipment's adopting safety practices			2									

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Applied Physics Lab

Code: DIP11148

Credits- 1 | Semester I

A. Introduction:

- To give an understanding of physical world by observations and measurements.
- Use of physical principles and analysis in various fields of engineering and technology is very prominence.
- To supplement the factual knowledge gained in the lecture with hands-on experience with the apparatus & developing skills in taking measurements.
- To develop scientific temper and help to apply the basic concepts and principles in solving engineering and technology based problems.

B. **Course Outcomes:** At the end of the course, students will be able

[CO1] Select right kind of measuring tools (Meter scale, Vernier caliper, Screw gauge, Spherometer) for determining dimensions of physical quantities and make measurements with accuracy and precision.

[CO2] Apply and verify laws of forces and determine resultant force acting on a body.

[CO3] Determine the velocity of sound in air.

[CO4] Understand the fall of a sphere through a viscous liquid

[CO5] Understand gravitational force & calculate the time of a pendulum.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

S.No	Name of Experiments
1.	To measure length, radius of a given cylinder, a test tube and a beaker using a Vernier caliper and find volume of each object.
2.	To determine diameter of a wire, a solid ball and thickness of cardboard using a screw gauge.
3.	To determine radius of curvature of a convex and a concave mirror surface using a spherometer.
4.	To verify experimentally the law of parallelogram of forces.

5.	To verify experimentally the law of converse of triangle of forces.
6.	To determine force constant of a spring using Hook's Law
7.	To find the viscosity of a given liquid (Glycerin) by Stoke's law.
8.	To verify experimentally the Lami's theorems.
9.	To determine the velocity of sound in air at room temperature and at 0 C by using Resonance Air Column method.
10.	To determine force constant of a spring using Hook's Law.
11.	To find the Moment of Inertia of a flywheel about its axis of rotation
12.	To find the time period of a simple pendulum for small amplitudes and draw the graph of length of the pendulum against square of the time period. Use the graph to find the length of the simple pendulum.

E. TEXT BOOKS

T1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi

T2. Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi

F. REFERENCE BOOKS

R1. Practical Physics by C. L. Arora, S. Chand & Company Ltd.

R2. e-books/e-tools/ learning physics software/you Tube videos/ websites etc.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES						CORRELATION WITH PROGRAM SPECIFIC OUTCOMES					
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Select right kind of measuring tools (Meter scale, Vernier caliper, Screw gauge, Spherometer) for determining dimensions of physical quantities and make measurements with accuracy and precision.				2								
[CO2]	Apply and verify laws of forces and determine resultant force acting on a body.			2	1								
[CO3]	Determine the velocity of sound in air.		2	1									
[CO4]	Understand the fall of a sphere through a viscous liquid						1						
[CO5]	Understand gravitational force & calculate the time of a pendulum.	2		1									

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Applied Chemistry Laboratory

Code:DIP11146

Credits- 1 | Semester I

A. Introduction:

- There are numerous number of materials used in fabricating and manufacturing devices for the comfort of life.
- The course aims to supplement the factual knowledge gained in the lectures by first hand manipulation of processes and apparatus.
- This will develop scientific temper and help to apply the basic concepts and principles in solving engineering problems.

B. Course Outcomes: At the end of the course, students will be able

[CO1] To express quantitative measurements accurately.
[CO2] To practice and adapt good measuring techniques.
[CO3] To use various apparatus for precise measurements.
[CO4] To understand and differentiate different methods of quantitative analysis.
[CO5] To know and understand principles of quantitative analysis using instruments.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

S.No	Name of Experiments
1	Preparation of standard solution of oxalic acid or potassium permanganate.
2	To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator.
3	Standardization of KMnO4 solution using standard oxalic acid and Determine the percentage ofiron present in given Hematite ore by KMnO4 solution.
4	Alkalinity of given water sample using 0.01M sulphuric acid

5	To determine the viscosity and relative viscosity of given sample by using Ostwald's Viscometer.
6	Volumetric estimation of total hardness of given water sample using standard EDTA solution.
7	Proximate analysis of coal a) Gravimetric estimation moisture in given coal sample
8	Determine the conductivity of given water sample.
9	Determination of the Iron content in given cement sample using colorimeter.
10	Determination of calorific value of solid or liquid fuel using bomb calorimeter.
11	Determination of flash and fire point of lubricating oil using Able's flash point apparatus.
12	Determination of viscosity of lubricating oil using Redwood viscometer.

D. TEXT BOOKS

T1.Dr. G. H. Hugar and Prof A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. Vol. II and NITTTR, Chandigarh, Publications, 2013-14, I

T2. Practical Chemistry by S.S. Dara

E. REFERENCE BOOKS

R1. Practical Chemistry by D N Bajpai – S. Chand Publishing

R2. Advanced Practical Chemistry Book by pragatiprakashan

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES						CORRELATION WITH PROGRAM SPECIFIC OUTCOMES					
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	To express quantitative measurements accurately.	1		1									
[CO2]	To practice and adapt good measuring techniques.		1		1							1	
[CO3]	To use various apparatus for precise measurements.			1									2
[CO4]	To understand and differentiate different methods of quantitative analysis.					1	1						
[CO5]	To know and understand principles of quantitative analysis using instruments.												

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: COMMUNICATION SKILLS IN ENGLISH LAB

Code: DIP11150

Credits- 1 | Semester I

A. Introduction:

- To develop listening skills for enhancing communication.
- To develop speaking skills with a focus on correct pronunciation and fluency.
- To introduce the need for Personality development- Focus will be on developing certain qualities, which will aid students in handling personal and career challenges, leadership skills etc. for that purpose group discussion, extempore and other activities should be conducted during lab classes.

B. Course Outcomes: At the end of the course, students will be able

[CO1] They will also demonstrate a significant increase in word power

[CO2] The variety of exercises and activities that will be conducted in the Language Lab will developtheir skills needed to participate in a conversation like listening carefully and respectfully to others' viewpoints; articulating their own ideas and questions clearly and over all students will be able to prepare, organize, and deliver an engaging oral presentation

[CO3] They will also develop non-verbal communication such as proper use of body language and gestures

[CO4] Managing personal and professional is life.

[CO5] Enhancing personality development

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

LISTENING SKILLS: Listening Process and Practice: Introduction to recorded lectures, poems, interviews and speeches, listening tests.

INTRODUCTION TO PHONETICS: Sounds: consonant, vowel, diphthongs, etc. transcription of words (IPA), weak forms, syllable division,word stress, intonation, voice etc.

SPEAKING SKILLS: Standard and formal speech: Group discussion, oral presentations, public speaking, business presentationsetc. Conversation practice and role-playing, mock interviews etc.

BUILDING VOCABULARY: Etymological study of words and construction of words, phrasal verbs, foreign phrases, idioms and phrases. Jargon/ Register related to organizational set up, word exercises and word games to enhance self-expression and vocabulary of participants.

E. TEXT BOOKS

T1. Daniel Jones. The Pronunciation of English. Cambridge: Cambridge University Press, 1956.
T2. James Hartman& et al. Ed. English Pronouncing Dictionary. Cambridge: Cambridge University35 First Year Curriculum Structure Common to All Branches Press, 2006.
T3. Kulbhushan Kumar, Effective Communication Skills, Khanna Publishing House, New Delhi (Revised Ed. 2018)
T4. J.D.O'Connor. Better English Pronunciation. Cambridge: Cambridge University Press, 1980.

F. REFERENCE BOOKS

R1. Lindley Murray. An English Grammar: Comprehending Principles and Rules. London: Wilsonand Sons, 1908.
R2. Margaret M. Maison. Examine your English. Orient Longman: New Delhi, 1964.
R3. J.Sethi& et al. A Practice Course in English Pronunciation. New Delhi: Prentice Hall, 2004.
R4. Pfeiffer, William Sanborn and T.V.S Padmaja. Technical Communication: A Practical Approach.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES						CORRELATION WITH PROGRAM SPECIFIC OUTCOMES					
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	They will also demonstrate a significant increase in word power			2						2			
[CO2]	exercises and activities that will be conducted in the Language	2							2				
[CO3]	develop non-verbal communication				2					2			
[CO4]	Managing personal and professionals life						2	2					
[CO5]	Enhancing personality development						2				2		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

ARKA JAIN University
Jharkhand

Syllabus of

Diploma in Mechanical Engineering

Semester-II

ARKAJAIN University, Jharkhand
School of Engineering & IT
Department of Engineering
Faculty – Diploma in Mechanical Engineering (DEME)
Scheme of Study (w.e.f Batch 2020-21)

SEMESTER –I (Group-A)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Communication Skills in English	HSC	3	3	100	70	20	5	5
2	Mathematics-I	BSC	4	4	100	70	20	5	5
3	Applied Physics	BSC	4	4	100	70	20	5	5
4	Applied Chemistry	BSC	4	4	100	70	20	5	5
	Practical								
5.	Engineering Workshop Practice	ESC	2	4	50	35	5	5	5
6.	Applied Physics Lab	BSC	1	2	50	35	5	5	5
7.	Applied Chemistry Lab	BSC	1	2	50	35	5	5	5
8.	Communication Skills in English Lab	HSC	1	2	50	35	5	5	5
	Total		**20**	**25**	**600**	**420**	**100**	**40**	**40**

SEMESTER I (Group-B)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Mathematics -I	BSC	4	4	100	70	20	5	5
2	Fundamentals of Electrical & Electronics Engg.	ESC	4	4	100	70	20	5	5
3	Introduction to IT system	ESC	3	3	100	70	20	5	5
4	Engineering Mechanics	ESC	4	4	100	70	20	5	5
5	Environmental Science	AC	0	2	50	35	10	2.5	2.5
	Practical								
6	Fundamentals of electrical & electronics Engg. Lab	ESC	1	2	50	35	5	5	5
7	Introduction to IT system Lab	ESC	1	2	50	35	5	5	5
8	Engineering Mechanics Lab	ESC	1	2	50	35	5	5	5
9	Engineering Graphics	ESC	2	4	50	35	5	5	5
	Total		**20**	**27**	**650**	**455**	**110**	**42.5**	**42.5**

SEMESTER II (Group-A)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Mathematics -II	BSC	4	4	100	70	20	5	5
2	Fundamentals of Electrical & Electronics Engg.	ESC	4	4	100	70	20	5	5
3	Introduction to IT system	ESC	3	3	100	70	20	5	5
4	Engineering Mechanics	ESC	4	4	100	70	20	5	5
5	Environmental Science	AC	0	2	50	35	10	2.5	2.5
	Practical								
6	Fundamentals of electrical & electronics Engg. Lab	ESC	1	2	50	35	5	5	5
7	Introduction to IT system Lab	ESC	1	2	50	35	5	5	5
8	Engineering Mechanics Lab	ESC	1	2	50	35	5	5	5
9	Engineering Graphics	ESC	2	4	50	35	5	5	5
	Total		**20**	**27**	**650**	**455**	**110**	**42.5**	**42.5**

SEMESTER –II(Group-B)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Communication Skills in English	HSC	3	3	100	70	20	5	5
2	Mathematics-II	BSC	4	4	100	70	20	5	5
3	Applied Physics	BSC	4	4	100	70	20	5	5
4	Applied Chemistry	BSC	4	4	100	70	20	5	5
	Practical								
5.	Engineering Workshop Practice	ESC	2	4	50	35	5	5	5
6.	Applied Physics Lab	BSC	1	2	50	35	5	5	5
7.	Applied Chemistry Lab	BSC	1	2	50	35	5	5	5
8.	Communication Skills in English Lab	HSC	1	2	50	35	5	5	5
	Total		**20**	**25**	**600**	**420**	**100**	**40**	**40**

SEMESTER-III

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Strength of Materials	PCC	4	4	100	70	20	5	5
2	Material Science & Engineering	PCC	3	3	100	70	20	5	5
3	Fluid Mechanics & Hydraulic Machinery	PCC	4	4	100	70	20	5	5
4	Manufacturing Technology-I	PCC	3	3	100	70	20	5	5
5	Thermal Engineering-I	PCC	3	3	100	70	20	5	5
	Practical								
6	Strength of Materials Lab	PCC	1	2	50	35	5	5	5
7	Fluid Mechanics & Hydraulic Machinery Lab	PCC	1	2	50	35	5	5	5
8	Manufacturing Technology-I Lab	PCC	1	2	50	35	5	5	5
9	Thermal Engineering- I Lab	PCC	1	2	50	35	5	5	5
10	Summer Internship-I(3-4 Weeks)	PROJ	2	0	50	35	15	0	0
	TOTAL		**23**	**25**	**750**	**525**	**135**	**45**	**45**

SEMESTER-IV

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Measurements & Metrology	PCC	3	3	100	70	20	5	5
2	Manufacturing Technology-II	PCC	4	4	100	70	20	5	5
3	Thermal Engineering - II	PCC	4	4	100	70	20	5	5
4	Elective-I Tool Engineering Heat Transfer Farm Equipment & Farm Machinery	PEC	3	3	100	70	20	5	5
5	Elective-II Computer Integrated Manufacturing Refrigeration & Air-conditioning Material Handling Systems	PEC	3	3	100	70	20	5	5
6	Essence of Indian Knowledge Tradition	AC	0	2	50	35	10	2.5	2.5
	Practical								
7	Measurements & Metrology Lab	PCC	1	2	50	35	5	5	5
8	Computer Aided Machine Drawing Practice Lab	PCC	1	2	50	35	5	5	5
9	Manufacturing Technology –II Lab	PCC	1	2	50	35	5	5	5
10	Thermal Engineering– II Lab	PCC	1	2	50	35	5	5	5
11	Minor Project	PROJ	2	4	50	35	15	0	0
	TOTAL		**23**	**31**	**800**	**560**	**145**	**47.5**	**47.5**

SEMESTER V

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory / Practical Exam	Mid Term Theory / Practical Exam	CIA*	Attendance
1	Advanced Manufacturing Processes	PCC	3	3	100	70	20	5	5
2	Theory of Machines & Mechanisms	PCC	3	3	100	70	20	5	5
3	Industrial Engineering & Management	PCC	3	3	100	70	20	5	5
4	Elective-III Computer Aided Design and Manufacturing Automobile Engineering Hybrid Vehicles	PEC	3	3	100	70	20	5	5
5	Elective-IV Industrial Robotics & Automation Power Plant Engineering Mechatronics	PEC	3	3	100	70	20	5	5
6	Open Elective-I Renewable Energy Technology Operation Research Internet of Thing	OEC	3	3	100	70	20	5	5
	PRACTICAL								
7	CAD/CAM Lab	PCC	1	2	100	70	20	5	5
8	Theory of Machines & Mechanisms Lab	PCC	1	2	50	35	5	5	5
9	Summer Internship-II(4-6 Weeks)	PROJ	3	0	100	70	30		
10	Major Project-I (Project to be carried over to next semester)	PROJ	1	2	50	35	15		
	TOTAL		**24**	**24**	**900**	**630**	**190**	**40**	**40**

SEMESTER VI

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory / Practical Exam	CIA*	Attendance
1	Design of Machine Elements	PCC	3	3	100	70	20	5	5
2	Production & Operations Management	PCC	3	3	100	70	20	5	5
3	Entrepreneurship and Start-ups	PROJ	4	4	100	70	20	5	5
4	Open Elective-II Sustainable Development Robotics Artificial Intelligent & Machine Learning	OEC	3	3	100	70	20	5	5
5	Open Elective-III Project Management Product Design Cyber Security Laws, Standards & IPR 3-D Printing	OEC	3	3	100	70	20	5	5
6	Indian Constitution	AC	0	2	50	35	10	2.5	2.5
	PRACTICAL								
7	Seminar	PROJ	1	2	50	35	15	0	0
8	Major Project-II	PROJ	3	0	100	70	30	0	0
	TOTAL		**20**	**20**	**700**	**490**	**155**	**27.5**	**27.5**

Distribution of Credit across 6 semesters:

Sl. No	Type of Paper	No. of Paper	Total Credit
1	Humanities and Social Sciences Courses **(HSC)**	3	7
2	Basic Science courses**(BSC)**	6	18
3	Engineering Science courses **(ESC)**	8	18
4	Professional core courses (**PCC)**	23	53
5	Professional Elective courses**(PEC)**	4	12
6	Open Electives Courses (**OEC)**	3	9
7	Project work, seminar and internship in industry or elsewhere**(PROJ)**	6	12
8	Audit Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]**(AC)**	3	(non-credit)
	Total	56	129

CIA – Continuous Internal Assessment – Based on Projects / Assignment during the semester

Note:

AICTE Activity Points to be earned by students admitted to Diploma program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 3 year Diploma program, is required to earn 75 activity points in addition to the total credits earned for the program. Students entering 3 years Diploma Program through lateral entry are required to earn 50 activity points in addition to the total credits earned for the program.
The activity points earned by the student shall be reflected on the students 6th Semester grade card.
The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled.
Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.
Incase student fail to earn the prescribed activity points, Sixth semester Grade Card shall be issued only after earning the required activity Points.
Students shall be eligible for the award of degree only after the release of the Six Semester grade card.

There are two groups (A & B) in semester 1 & 2. The Group division will be decided by The Dean SoE& IT before commencement of classes*

ARKAJAIN University, Jharkhand
School of Engineering & IT
Department of Engineering
Faculty – Diploma in Mechanical Engineering (DEME)
PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PROGRAM OUTCOMES

After completing this undergraduate program, a learner:

PO.1]. Basic knowledge: An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems

[PO.2]. Discipline knowledge: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.

[PO.3]. Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

[PO.4]. Engineering Tools: Apply appropriate technologies and tools with an understanding of the limitation.

[PO.5]. The engineer and society: Demonstrate knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering practice.

[PO.6]. Environment and sustainability: Understand the impact of the engineering solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development..

[PO.7]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

[PO.8]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse/multidisciplinary teams.

[PO.9]. Communication: An ability to communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.10]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological changes.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Maintenance selection and use of various equipment and machinery and instruments in mechanical processes.

[PSO.2]. Supervise and manage production process and demonstrate a knowledge of management and business practices, such as risk and change management, and understand their limitations.

Subject: Mathematics- II

Code:DIP12008

4 Credits | Semester II

A. Introduction:

- To study the functions and this course enables the students to understand the calculus in engineering problems.
- To learn solve system of linear equation by using matrix and determinants.
- To gain profiency in calculus computations.
- for analyzing and describing the behavior of functions limits derivatives and integrals

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Remembering several areas of mathematics beyond calculus

[CO2] Understand to solve differential equations using appropriate methods.

[CO3] Analyzing theConcepts of differentiation in physics & engineering courses

[CO4] Evaluating the ODE of first degree, first order in engineering field

[CO5] Creating interest in mathematics

C. Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

MATRICES AND DETERMINANTS: Matrices: Basic concepts of matrices: Definition, types of matrices and mathematical operations on matrices (addition, subtraction and multiplication of matrices).**Determinant:** Definition, problems on finding the determinant value of 2^{nd} and 3^{rd} order. Problems on finding unknown quantity in a 2^{nd} and 3^{rd} order determinants using expansion. Solving simultaneous linear equations using matrix method (Cramer's rule up to 3rd order).Inverse and applications of matrices: Minors and Cofactors of elements of matrix. Adjoin and Inverse of matrices of order 2ndand 3rd order. Elementary row and column operations on matrices. Characteristic equation and characteristic roots (Eigen values) of 2x2 matrix. Statement of Cayley-Hamilton theorem and its verification for 2x2 matrixes.

DIFFERENTIAL CALCULUS: Constants and variables. Definition of function. Types of functions: Explicit and implicit function, odd and even functions-2. Concept of $x \to a$.Definition of limit of a function. Indeterminate forms. Evaluation of limit of functions by factorization, rationalization. Algebraic limitStatement of $\lim_{x\to a} \frac{x^n - a^n}{x-a} = na^{n-1}$ where n is any rational number. Proof of $\lim_{\theta\to 0} \frac{\sin\theta}{\theta} = 1$where$\theta$ is in radian. Related problems.Derivatives of functions ofx^n, $\sin x$, $\cos x$&$\tan x$with respect to 'x' from first principle method Rules of differentiation: Sum, product, quotient rule & problems on rules.Derivatives of function of a function (Chain rule) & problems. Inverse trigonometric functions & their derivatives. Implicit functions, Parametric functions & problems, differentiation of exponential and Logarithmic, second order differentiation.

APPLICATION OF DIFFERENTIATION: Geometrical meaning of derivative. Derivative as slope. Equations of tangent & normal to the curve y = f(x) at a given point- (statement only)
Derivative as a rate measure i.e.to find the rate of change of displacement, velocity, radius, area, volume-using differentiationDefinition of increasing & decreasing functionMaxima& minima of a function

INTEGRAL CALCULUS, DEFINITE INTEGRAL & ITS APPLICATIONS: Definition of Integration. List of standard integrals. Rules of integration (only statement)problems.-1, Integration by substitution method. Problems. Standard integrals. Integration by parts definite integration &problemsArea, volume, centers of gravity & moment of inertia by integration method. Simple problems

DIFFERENTIAL EQUATION: Definition, example, order & degree of differential equation with examples Formation of differential equation by eliminating arbitrary constants up to second order.Solution of O. D. E of first degree & first order by variable separable method
Linear differential equations & its solution using integrating factor.

E. TEXT BOOKS

F. REFERENCE BOOKS

R1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 40th Edition, 2007.
R2. G. B. Thomas, R. L. Finney, Calculus and Analytic Geometry, Addison Wesley, 9th Edition, 1999.
R3. NCERT Mathematics Text books of class XI and XII.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES	CORRELATION WITH PROGRAM SPECIFIC OUTCOMES										
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Remembering several areas of mathematics beyond calculus	1			1								
[CO2]	Understand to solve differential equations using appropriate methods		1			1							
[CO3]	Analyzing the Concepts of differentiation in physics & engineering courses	1		1									
[CO4]	Evaluating the ODE of first degree, first order in engineering field	1				1							
[CO5]	Creating interest in mathematics					1					1		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Fundamentals of Electrical and Electronics Engineering

Code:

4 Credits |Semester II

A. Introduction:

- To provide basic knowledge of the different elements and concepts of electrical engineering field.
- To learn basic concepts of various active and passive electronic components, Signals, Op-Amp and their applications, Digital Electronics and their applications to help students deal with electrical and electronics engineering principles and applications in industrial processes of different fields.
- To impart knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.
- To provide working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices.
- To explain the working principle, construction, applications of DC machines, AC machines & measuring instruments.
- To highlight the importance of transformers in transmission and distribution of electric power.

B. Course Outcomes: At the end of the course,

[CO1] Remembering the basic terminology/definitions of electrical component & Signals

[CO2] Understanding the Analog electronic Specially Op-Amp & Digital Electronics and their applications

[CO3] Applying the knowledge of theorems/laws for Predict the behavior of any electrical and magnetic circuitsand Use the principles of electromagnetic induction in electrical applications

[CO4] Analyzing the formulation and solution of simple and complex AC, Dc circuits

[CO5] Evaluatingthe requirement of transformers and the type of electrical machine used for that particular application

C. Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

OVERVIEW OF ELECTRONIC COMPONENTS & SIGNALS: Passive Active Components: Resistances, Capacitors, Inductors, Diodes, Transistors, FET, MOS andCMOS and their Applications. Signals: DC/AC, voltage/current, periodic/non-periodic signals, average,Rms, peak values, different types of signal waveforms, Ideal/non-ideal voltage/current sources Independent/dependent voltage current sources. Overview of electrical & electronics engineering field

OVERVIEW OF ANALOG CIRCUITS AND DIGITAL ELECTRONICS: Operational Amplifiers-Ideal Op-Amp, Practical op amp, Open loop and closed loop configurations, Application of Op-Amp as amplifier, adder, differentiator and integrator. Introduction to Boolean Algebra, Electronic Implementation of Boolean Operations, Gates-Functional Block Approach, Storage elements-Flip Flops-A Functional block approach, Counters: Ripple, Up/down and decade, Introduction to digital IC Gates (of TTL Type).

ELECTRIC AND MAGNETIC CIRCUITS: EMF, Current, Potential Difference, Power and Energy; M.M.F, magnetic force, permeability, hysteresis loop, reluctance, leakage factor and BH curve;Electromagnetic induction, Faraday's laws of electromagnetic induction, Lenz's law; Dynamically induced emf; Statically induced emf; Equationsof self and mutual inductanceAnalogy between electric and magnetic circuits.

A.C. CIRCUITS: Cycle, Frequency, Periodic time, Amplitude, Angular velocity, RMS value, Average value, Form Factor Peak Factor, impedance, phase angle, and power factor; Mathematical and phasor representation of alternating emf and currentVoltage and Current relationship in Star and Delta connections; A.C in resistors, inductors and capacitors; A.C in R-L series, R-C series, R-L-C series and parallel circuits; Power in A. C. Circuits, power triangle.

TRANSFORMER AND MACHINES: Classification: Static & dynamic (rotary) machines, examples. Transformer: Definition, study of principle of operation of transformer, derivation of EMF equation, turns ratio, voltage transformation ratio, step-up & step-down transformers, losses, efficiency, regulation, & simple problemsClassification Transformers: Based on cores, frequency, power and application, & their featuresDC machines: Principle of operation & features of DC motors &generatorsACmachines:Features of AC motors & alternators

E. TEXT BOOKS

T1. Basic Electrical Engineering, V. K. Mehta and Rohit Mehta, S. Chand and Company Publishers, RE 2012, ISBN 81219087

T2. Theraja, B. L., Electrical Technology Vol – I, S. Chand Publications, New Delhi, 2015, ISBN:9788121924405

T3. Theraja, B. L., Electrical Technology Vol – II, S. Chand Publications, New Delhi, 2015, ISBN:9788121924375
T4. Electronic Components, Dr. K. Padmanabhan and P. Swaminathan, Lakshmi Publications, 2006.

F. REFERENCE BOOKS

R1. Fundamentals Of Electric Circuits, 5Th Edn Edition-5, Charles K. Alexander And Matthew N.O. Sadiku, Publisher McGraw Hill India.

R2. Circuit Theory Analysis and Synthesis Paperback – 2018 by AbhijitChakrabarti (Author), publisher DhanpatRai and Co.

R3. Electronics: Fundamentals and Applications by D. Chattopadhyay and P. C. Rakshit, publication - new age international publishers.

R4. RituSahdev, Basic Electrical Engineering, Khanna Publishing House

R5. Mittle and Mittal, Basic Electrical Engineering, McGraw Education, New Delhi, 2015, ISBN :978-0-07-0088572-5

R6. Saxena, S. B. Lal, Fundamentals of Electrical Engineering, Cambridge University Press, latesteditionISBN : 9781107464353

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Remembering the basic terminology/definitions of electrical component & Signals	2	1										
[CO2]	Understanding the Analog electronic Specially Op-Amp & Digital Electronics and their applications			2	3								
[CO3]	Applying the knowledge of theorems/laws for Predict the behavior of any electrical and magnetic circuitsand Use the principles of electromagnetic induction in electrical applications					2		2					
[CO4]	Analyzing the formulation and solution of simple and complex AC, Dc circuits						2		1				
[CO5]	Evaluatingthe requirement of transformers and the type of electrical machine used for that particular application									1	2		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Introduction to IT Systems

Code:DIP12157

Credits - 3 | Semester II

A. Introduction:

- This course is intended to make new students understand computing environment - Learning basic computer skills, learning basic application software tools, understanding computer hardware, cyber security awareness

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Comfortably work on computer, install and configure OS

[CO2] Assemble a PC

[CO3] Connect it to external devices, write documents,

[CO4] Create worksheets, prepare presentations

[CO5] Protect information and computers from basic abuses/ attacks.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

INTRODUCTION: Computer, Functional part of computers, history and evolution of computersBasic internet skills: understanding browser, efficient use of search engines, awareness about Digital India portals (state and national portals), college portals Hardware and software, Advantages and disadvantages of computers.Memory: primary memory (RAM and ROM) and secondary memory, HDD and other peripheral devices

INTRODUCTION TO OPERATING SYSTEM: My computer, recycle bin, status bar, Start and Menu Selection, Creating and rename of files and folders, Copy, paste, moving files , opening and closing of different windows.Introduction to DOS, DOS commands, OS Installation (Linux and MS Windows)Unix Shell and Commands, vi editor.

INTRODUCTION TO OFFICE TOOLS: Open Office writer, Open Office spreadsheet, Open Office Impressworking with MS-Word-inserting text, word art, table, images, adding

background**Powerpoint:-** Difference between presentation and documents, Title, Text Creation: Fonts and size, Bullets ,moving to next slides, Presentation of slides: Selection of types of slides, slide show and presentation

INTRODUCTION TO INTERNET: Introduction to Internet, WWW and Web Browsers: Basic of Computer networks; LAN, WAN; Applications of Internet; World Wide Web; Web Browsing software, Search Engines; Understanding URL; Domain name; IP Address; Using e-governance websiteHTML4, CSS, making personal webpages

INFORMATION SECURITY BEST PRACTICES: Information security, Hacking, cryptography and its applications

E. TEXT BOOKS

T1. Online Resources, Linux man pages, Wikipedia
T2. Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett

F. REFERENCE BOOKS

R1. R. S. Salaria, Computer fundamentals, Khanna publication house
R2. Computer Fundamentals Concepts, Systems, Application, D.P.Nagapal, S.Chand Publication
R3. Ramesh Bangia, PC Software Made Easy – The PC Course Kit, Khanna Publishing House

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Comfortably work on computer, install and configure OS	1			3								
[CO2]	Assemble a PC			2									
[CO3]	Connect it to external devices, write documents,										2		
[CO4]	Create worksheets, prepare presentations									1			
[CO5]	Protect information and computers from basic abuses/ attacks.						1						

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Engineering Mechanics

Code:DIP12153

Credits- 3 | Semester II

A. Introduction:

- To obtain resultant of various forces
- To obtain resultant of various forces
- To understand role of friction in equilibrium problems
- To know fundamental laws of machines and their applications to various engineering problems

B. Course Outcomes: At the end of the course, students will be able

[CO1] Identify the force systems for given conditions by applying the basics of mechanics.
[CO2] Determine unknown force(s) of different engineering systems.
[CO3] Apply the principles of friction in various conditions for useful purposes.
[CO4] Find the centroid and centre of gravity of various components in engineering systems.
[CO5]Select the relevant simple lifting machine(s) for given purposes.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

BASICS OF MECHANICS AND FORCE SYSTEM: Basic concepts, applied mechanics, Statics, Dynamics.Space, time, mass, particle, flexible body and rigid body.Scalar and vector quantity, Units of measurement (SI units) - Fundamental units and derived units.Force – unit, representation as a vector and by Bow's notation, characteristics and effects of a force, Principle of transmissibility of force, Force system and its classification.Resolution of a force - Orthogonal components of a force, moment of a force, Varignon'sTheorem.Composition of forces – Resultant, analytical method for determination of resultant for concurrent, non-concurrent and parallel co-planar force systems – Law of triangle, parallelogram and polygon of forces.

EQUILIBRIUM: Equilibrium and Equilibrant, Free body and Free body diagram, Analytical and graphical methods of analyzing equilibrium**,** Lami's Theorem – statement and explanation, Application for various engineering problems.Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, uniformly distributed load,

couple),Beam reaction for cantilever, simply supported beam with or without overhang – subjected to combination of Point load and uniformly distributed load, Beam reaction graphically for simply supported beam subjected to vertical point loads only

FRICTION & VIRTUAL WORK: Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction.Introduction, laws of coulomb friction, simple contact friction problems, belt friction, the square crew thread rolling resistance, Equilibrium of bodies on level surface subjected to force parallel and inclined to plane. Equilibrium of bodies on inclined plane subjected to force parallel to the plane only.Work of a force, Principle of Virtual work and its application.

CENTROID AND CENTRE OF GRAVITY& TRUSS: Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle),Centroid of composite figures composed of not more than three geometrical figures, Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere) Centre ofGravity of composite solids composed of not more than two simple solids.The structural model, simple trusses, analysis of simple trusses: method of joints, Method of sections, graphical method.

SIMPLE LIFTING MACHINE: Simple lifting machine, load, effort, mechanical advantage, applications and advantages. Velocity ratio, efficiency of machines, law of machine.Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines, conditions for reversibility, Velocity ratios of Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Simple screw jack, Weston's differential pulleyblock, geared pulley block.

E. TEXT BOOKS

T1.D.S. Bedi, Engineering Mechanics, Khanna Publications, New Delhi (2008)
T2.Khurmi, R.S., Applied Mechanics, S. Chand & Co. New Delhi.
T3.Bansal R K, A text book of Engineering Mechanics, Laxmi Publications.
T4.Ramamrutham, Engineering Mechanics, S. Chand & Co. New Delhi.
T5.Dhade, Jamadar&Walawelkar, Fundamental of Applied Mechanics, Pune Vidhyarthi Gruh.

F. REFERENCE BOOKS

R1. Ram, H. D.; Chauhan, A. K., Foundations and Applications of Applied Mechanics, CambridgeUniversity Press.
R2. Meriam, J. L., Kraige, L.G., Engineering Mechanics- Statics, Vol. I, Wiley Publication, New Delhi.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Identify the force systems for given conditions by applying the basics of mechanics.	3	3								3		2
[CO2]	Determine unknown force(s) of different engineering systems.		3								3		3
[CO3]	Apply the principles of friction in various conditions for useful purposes.		3								3		1
[CO4]	Find the centroid and centre of gravity of various components in engineering systems.	3			3								2
[CO5]	Select the relevant simple lifting machine(s) for given purposes.	3									3		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Environmental Sciences

Code: DIP12155

0 Credits | Semester II

A. Introduction:

- Solve various engineering problems applying ecosystem to produce eco – friendly products.
- Use relevant air and noise control method to solve domestic and industrial problems.
- Use relevant water and soil control method to solve domestic and industrial problems.
- To recognize relevant energy sources required for domestic and industrial applications.
- Solve local solid and e-waste problems.

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Understand the ecosystem and terminology and solve various engineering problems applying

[CO2] Ecosystem knowledge to produce eco – friendly products.

[CO3] Understand the suitable air, extent of noise pollution, and control measures and acts.

[CO4] Understand the water and soil pollution, and control measures and acts.

[CO5] Understand different renewable energy resources and efficient process of harvesting.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	10
	Attendance	2.5
	Assignment	2.5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

ECOSYSTEM: Structure of ecosystem, Biotic & Abiotic components, Food chain and food web Aquatic (Lentic and Lotic) and terrestrial ecosystem Carbon, Nitrogen, Sulphur, Phosphorus cycle.Global warming -Causes, effects, process, Green House Effect, Ozone depletion

AIR AND NOISE POLLUTION: Definition of pollution and pollutant, Natural and manmade sources of air pollution (Refrigerants, I.C., Boiler)Air Pollutants: Types, Particulate Pollutants: Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator) Gaseous Pollution Control:Absorber, Catalytic Converter, Effects of air pollution due to Refrigerants, I.C., Boiler

Noise pollution: sources of pollution, measurement of pollution level,Effects of Noise pollution, Noise pollution (Regulation and Control) Rules, 2000

WATER AND SOIL POLLUTION: Sources of water pollution, Types of water pollutants, Characteristics of water pollutants Turbidity, pH, total suspended solids, total solids BOD and COD: Definition, calculationWaste Water Treatment: Primary methods: sedimentation, froth floatation, Secondary methods: Activated sludge treatment, Trickling filter, Bioreactor, Tertiary Method: Membrane separation technology, RO (reverse osmosis). Causes, Effects and Preventive measures of Soil Pollution: Causes-Excessive use of Fertilizers, Pesticides and Insecticides, Irrigation, E-Waste.

RENEWABLE SOURCES OF ENERGY: Solar Energy: Basics of Solar energy. Flat plate collector (Liquid & Air). Theory of flat plate collector. Importance of coating. Advanced collector. Solar pond. Solar water heater, solar dryer. Solar stills.Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel. Anaerobic digestion. Biogas production mechanism. Utilizationand storage of biogas.Wind energy: Current status and future prospects of wind energy. Wind energy in India. Environmental benefits and problem of wind energy. New Energy Sources: Need of new sources. Different types new energy sources. Applications of (Hydrogen energy, Ocean energy resources, Tidal energy conversion.) Concept, origin andpower plants of geothermal energy.

SOLID WASTE MANAGEMENT, ISO 14000 & ENVIRONMENTAL MANAGEMENT: Solid waste generation- Sources and characteristics of: Municipal solid waste, E- waste, biomedical waste. Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries. Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste Air quality act 2004, air pollution control act 1981, water pollution, and control act1996. Structure and role of Central and state pollution control board. Concept of Carbon Credit, Carbon Footprint. Environmental management in fabrication industryISO14000: Implementation in industries, Benefits.

E. TEXT BOOKS

T1. Metcalf & Eddy, Waste Water Engineering, Mc-Graw Hill, New York, 2013, ISBN: 077441206.
T2. Keshav Kant, Air Pollution & Control, Khanna Publishing House, New Delhi (Edition 2018)

F. REFERENCE BOOKS

R1. S.C. Sharma & M.P. Poonia, Environmental Studies,Khanna Publishing House,NewDelhi
R2. C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.
First Year Curriculum Structure Common to All Branches 52
R3. Arceivala, Soli Asolekar, Shyam, Waste Water Treatment for Pollution Control and

R4. Reuse, Mc-Graw Hill Education India Pvt. Ltd., New York, 2007, ISBN:978-07-062099-
R5. Nazaroff, William, Cohen, Lisa, Environmental Engineering Science, Willy, New York, 2000,ISBN 10: 0471144940.
R6. O.P. Gupta, Elements of Environmental Pollution Control, Khanna Publishing House, New Delhi
R7. Rao, C. S., Environmental Pollution Control and Engineering, New Age International Publication,2007, ISBN: 81-224-1835-X.
R8. Rao, M. N.Rao, H.V.N, Air Pollution, Tata Mc-Graw Hill Publication, New delhi, 1988, ISBN: 0-07-451871-8.
R9. Frank Kreith, Jan F Kreider, Principles of Solar Engineering, McGraw-Hill, New York ; 1978,ISBN: 9780070354760.
R10. Aldo Vieira, Da Rosa, Fundamentals of renewable energy processes, Academic Press Oxford,UK; 2013. ISBN: 9780123978257.
R11. Patvardhan, A.D, Industrial Solid Waste, Teri Press, New Delhi, 2013, ISBN:978-81-7993-502-6

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Understand the ecosystem and terminology and solve various engineering problems applying						3						
[CO2]	Ecosystem knowledge to produce eco – friendly products.					2	2						
[CO3]	Understand the suitable air, extent of noise pollution, and control measures and acts.						2						
[CO4]	Understand the water and soil pollution, and control measures and acts.						2						
[CO5]	Understand different renewable energy resources and efficient process of harvesting.										2		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Engineering Graphics

Code:DIP12152

Credits2 | Semester II

A. Introduction:

- To understand the language of graphics, which is used to express ideas, convey instructions while carrying out engineering jobs.
- To develop drafting and sketching skills, to know the applications of drawing equipment and get familiarize with Indian Standards related to engineering drawings.
- To develop skills to visualize actual object or a part of it based on drawings.
- To develop skills to translate ideas into sketches and to draw and read various engineering curves, projections and dimensioning styles.

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Understand the language of graphics and familiarize with Indian Standards related to engineering drawings

[CO2] Develop drafting and sketching skills, application of drawing equipment's.

[CO3] Read various engineering curves, projections and dimensioning styles.

[CO4] Develop skills to translate ideas into sketches and draw.

[CO5] Develop skills to visualize actual object or a part of it, based on drawings.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

BASIC ELEMENTS OF DRAWING: Drawing Instruments and supporting materials, Convention of lines and their applications.Dimensioning techniques as per SP-46:2003 – types and applications of chain, parallel and coordinate dimensioning.Representative Fractions – reduced, enlarged and full size scales; Engineering Scales such as plain and diagonal scale.Geometrical and Tangency constructions.

ORTHOGRAPHIC PROJECTIONS OF POINTS AND LINES: Introduction to orthographic projection, First angle and Third angle method, their symbols.Conversion of pictorial view into Orthographic Views – object containing plain surfaces, slanting surfaces, slots, ribs, cylindrical surfaces.Projections of points Projections of lines in different quadrants, inclinations, True lengths of the lines projections on auxiliary planes

PROJECTIONS OF PLANE FIGURES: Different cases of plane figures (of different shapes) making different angles with one or both reference planes and lines lying in the plane figures making different given angles (with one or both reference planes).

PROJECTION OF SOLIDS: Types of Solid. Projection of Cone, Cylinder, Prism &pyramids.Simple cases when solid are placed in different positions Axis faces and tines lying in the faces of the solid making given angles.

ISOMETRIC PROJECTION: Introduction to isometric projections. Isometric scale and Natural scale.Isometric view and isometric projection. Illustrative problems related to objects containing lines, circles and arcs shape only

E. TEXT BOOKS

T1. Engineering Graphics, Agrawal B. & Agrawal C. M, TMH Publication
T2. Textbook on Engineering Drawing, Narayana, K.L. & P Kannaiah, Scitech Publishers

F. REFERENCE BOOKS

R1. Engineering Graphics, N.D Bhatt, Charotar Publishing House Pvt. Limited
R2. Principle of Engineering Graphics and Drawing, R.K Dhawan, S. Chand Publishing
R3. Engineering Graphics and Drafting, P.S GILL, S. K. Kataria& Sons
R4. Engineering Drawing and Computer Graphics, Shah, M.B. &Rana B.C. PearsonEducation

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Understand the language of graphics and familiarize with Indian Standards related to engineering drawings	2	1		1								
[CO2]	Develop drafting and sketching skills, application of drawing equipment's.				1								2
[CO3]	Read various engineering curves, projections and dimensioning styles.												
[CO4]	Develop skills to translate ideas into sketches and draw.	1											
[CO5]	Develop skills to visualize actual object or a part of it, based on drawings.											2	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Fundamentals of Electrical and Electronics EngineeringLab

Code:DIP12156

Credits- 1 | Semester II

A. Introduction:

- To provide basic knowledge of the different elements and concepts of electrical engineering field.
- To learn basic concepts of various active and passive electronic components applications in industrial processes of different fields

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Remembering basic problems related to electrical circuits

[CO2] Understanding operation of different electrical technologies.

[CO3] Analyzing different types of signal waveforms.

[CO4] Evaluating a various electronic circuits.

[CO5] Use relevant electric/electronic protective devices safely.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

LIST OF PRACTICALS	
1	Determine the resistance of a given unknown resistor experimentally and compare it with its colour coded value.
2.	Determine voltage, current and power in R-L series circuit.
3.	Demonstrate the verification of Ohm's law.
4	Compute the effective resistance experimentally for the following combinations: Three resistors are connected in (a) series and (b) parallel.
5	Connect capacitors in series and parallel combination on bread board and

	measure its value using multimeter.
6.	Demonstrate the verification of Kirchhoff's Current Law (KCL).
7	Demonstrate the verification of Kirchhoff's Voltage Law (KVL).
8	Demonstrate the characteristics of Half Wave Rectifier.
9	Test the PN-junction diodes using digital multimeter and measure the performance of PN-junction diode.
10	Demonstrate the characteristics of full Wave Rectifier.
11	Verify experimentally Thevenin's theorem
12	Verify experimentally Norton's theorem

E. TEXT BOOKS

T1. RituSahdev, Basic Electrical Engineering, Khanna Publishing House, 2018
T2. Mittle and Mittal, Basic Electrical Engineering, McGraw Education, New Delhi, 2015, ISBN : 978-0-07-0088572-5
T3. Saxena, S. B. Lal, Fundamentals of Electrical Engineering, Cambridge University Press, latest edition ISBN : 9781107464353
T4. Theraja, B. L., Electrical Technology Vol – I, S. Chand publications, New Delhi, 2015, ISBN: 9788121924405

F. REFERENCE BOOKS

R1. Theraja, B. L., Electrical Technology Vol – II, S. Chand publications, New Delhi, 2015, ISBN:9788121924375
R2. Jegathesan, V., Basic Electrical and Electronics Engineering, Wiley India, New Delhi, 2015, ISBN : 97881236529513
R3. Sedha, R.S., A text book of Applied Electronics, S.Chand ,New Delhi, 2008, ISBN-13: 978-8121927833
R4. Mehta, V.K., Mehta, Rohit, Principles of Electronics, S. Chand and Company, New Delhi, 2014,ISBN-13-9788121924504
R5. Bell Devid, Fundamental of Electronic Devices and Circuits, Oxford University Press, NewDelhi 2015 ISBN : 9780195425239

F. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Remembering basic problems related to electrical circuits	1		2									
[CO2]	Understanding operation of different electrical technologies.		1		3								
[CO3]	Analyzing different types of signal waveforms.					2							
[CO4]	Evaluating a various electronic circuits.		2										
[CO5]	Use relevant electric/electronic protective devices safely.							2					

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Introduction toIT System Lab

Code:

Credits- 1 | Semester II

A. Introduction:

- This Lab course is intended to practice whatever is taught in theory class of 'Introduction of IT Systems'and become proficient in using computing environment - basic computer skills, basic application software tools, Computer Hardware, cyber security features, etc.

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Comfortably work on computer, install and configure OS
[CO2] Assemble a PC
[CO3] Connect it to external devices, write documents,
[CO4] Create worksheets, prepare presentations
[CO5] Protect information and computers from basic abuses/ attacks.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

LIST OF PRACTICALS	
1	Introduction to various hardware components of a computer.
2.	Introduction to various e-governance/ Digital India portals, understanding their features
3.	Installing Linux/DOS and performing commands
4	HTML program to create a web page
5	HTML program to create a List of items and table
6.	HTML program to create a bio data using CSS

7	Creating a text file using Open Office/ MS-word
8	Creating a text file and adding borders, tables, word art etc
9	Creating a PPt using Open Office/ MS Powerpoint
10	Creating a slide show for the powerpoint presentation

E. TEXT BOOKS

T1. IT Essentials PC Hardware and Software Companion Guide, Davis Anfinson and Ken Quamme, CISC Press, Pearson Education.

T2. PC Hardware and A+ Handbook, Kate J. Chase PHI (Microsoft).

F. REFERENCE BOOKS

R1. Online resources, Linux man pages, Wikipedia.

R2. R.S. Salaria, Computer Fundamentals, Khanna Publishing House.

R3. Ramesh Bangia, PC Software Made Easy – The PC Course Kit, Khanna Publishing House.

R4. Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES			CORRELATION WITH PROGRAM SPECIFIC OUTCOMES								
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Comfortably work on computer, install and configure OS	**1**			**3**								
[CO2]	Assemble a PC			**2**									
[CO3]	Connect it to external devices, write documents,										**2**		
[CO4]	Create worksheets, prepare presentations									**1**			
[CO5]	Protect information and computers from basic abuses/ attacks.						**1**						

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Engineering Mechanics Lab

Code:DIP12154

Credits- 1 | Semester II

A. Introduction:

- To obtain resultant of various forces.
- To calculate support reactions through conditions of equilibrium for various structures
- To understand role of friction in equilibrium problems
- To know fundamental laws of machines and their applications to various engineering problems

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Identify the force systems for given conditions by applying the basics of mechanics.
[CO2] Determine unknown force(s) of different engineering systems.
[CO3] Apply the principles of friction in various conditions for useful purposes.
[CO4] Find the centroid and center of gravity of various components in engineering systems.
[CO5] Select the relevant simple lifting machine(s) for given purposes..

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

LIST OF PRACTICALS	
1.	To study various equipment is relate to Engineering Mechanics.
2.	To find the M.A., V.R., Efficiency and law of machine for Differential Axle and Wheel.
3.	To find the M.A., V.R., Efficiency and law of machine for Simple Screw Jack.
4.	Derive Law of machine using Worm and worm wheel.
5.	Derive Law of machine using Single purchase crab.
6.	Derive Law of machine using double purchase crab.
7.	Derive Law of machine using Weston's differential or wormed geared pulley block.
8.	Determine resultant of concurrent force system applying Law of Polygon of forces using

	forcetable.
9.	Determine resultant of concurrent force system graphically.
10.	Determine resultant of parallel force system graphically.
11.	Verify Lami's theorem
12.	Study forces in various members of Jib crane.
13.	Obtain support reactions of beam using graphical method.
14.	Determine coefficient of friction for motion on horizontal and inclined plane.
15.	Determine centroid of geometrical plane figures.
16.	Determine support reactions for simply supported beam.

E. TEXT BOOKS

T1. Ram, H. D.; Chauhan, A. K. Foundations and Applications of Applied Mechanics, Cambridge UniversityPress.

T2. Meriam, J. L., Kraige, L.G. , Engineering Mechanics- Statics, Vol. I, Wiley Publication, New Delhi.

F. REFERENCE BOOKS

R1. Bedi D.S., Engineering Mechanics, Khanna Publishing House

R2. Khurmi, R.S., Applied Mechanics, S.Chand& Co. New Delhi.

R3. Bansal R K, A text book of Engineering Mechanics, Laxmi Publications.

R4. Ramamrutham, Engineering Mechanics, S.,S Chand & Co. New Delhi.

R5. Dhade, Jamadar&Walawelkar, Fundamental of Applied Mechanics, Pune VidhyarthiGruh.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES			CORRELATION WITH PROGRAM SPECIFIC OUTCOMES								
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Identify the force systems for given conditions by applying the basics of mechanics.	1		2									
[CO2]	Determine unknown force(s) of different engineering systems.		1		3								
[CO3]	Apply the principles of friction in various conditions for useful purposes.					2							
[CO4]	Find the centroid and center of gravity of various components in engineering systems.		2										
[CO5]	Select the relevant simple lifting machine(s) for given purposes..							2					

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

ARKA JAIN University
Jharkhand

Syllabus of

Diploma in Mechanical Engineering

Semester-III

ARKAJAIN University, Jharkhand
School of Engineering & IT
Department of Engineering
Faculty – Diploma in Mechanical Engineering (DEME)
Scheme of Study (w.e.f Batch 2020-23)

SEMESTER –I (Group-A)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Communication Skills in English	HSC	3	3	100	70	20	5	5
2	Mathematics-I	BSC	4	4	100	70	20	5	5
3	Applied Physics	BSC	4	4	100	70	20	5	5
4	Applied Chemistry	BSC	4	4	100	70	20	5	5
	Practical								
5.	Engineering Workshop Practice	ESC	2	4	50	35	5	5	5
6.	Applied Physics Lab	BSC	1	2	50	35	5	5	5
7.	Applied Chemistry Lab	BSC	1	2	50	35	5	5	5
8.	Communication Skills in English Lab	HSC	1	2	50	35	5	5	5
	Total		**20**	**25**	**600**	**420**	**100**	**40**	**40**

SEMESTER I (Group-B)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Mathematics -I	BSC	4	4	100	70	20	5	5
2	Fundamentals of Electrical & Electronics Engg.	ESC	4	4	100	70	20	5	5
3	Introduction to IT system	ESC	3	3	100	70	20	5	5
4	Engineering Mechanics	ESC	4	4	100	70	20	5	5
5	Environmental Science	AC	0	2	50	35	10	2.5	2.5
	Practical								
6	Fundamentals of electrical & electronics Engg. Lab	ESC	1	2	50	35	5	5	5
7	Introduction to IT system Lab	ESC	1	2	50	35	5	5	5
8	Engineering Mechanics Lab	ESC	1	2	50	35	5	5	5
9	Engineering Graphics	ESC	2	4	50	35	5	5	5
	Total		**20**	**27**	**650**	**455**	**110**	**42.5**	**42.5**

SEMESTER II (Group-A)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Mathematics -II	BSC	4	4	100	70	20	5	5
2	Fundamentals of Electrical & Electronics Engg.	ESC	4	4	100	70	20	5	5
3	Introduction to IT system	ESC	3	3	100	70	20	5	5
4	Engineering Mechanics	ESC	4	4	100	70	20	5	5
5	Environmental Science	AC	0	2	50	35	10	2.5	2.5
	Practical								
6	Fundamentals of electrical & electronics Engg. Lab	ESC	1	2	50	35	5	5	5
7	Introduction to IT system Lab	ESC	1	2	50	35	5	5	5
8	Engineering Mechanics Lab	ESC	1	2	50	35	5	5	5
9	Engineering Graphics	ESC	2	4	50	35	5	5	5
	Total		**20**	**27**	**650**	**455**	**110**	**42.5**	**42.5**

SEMESTER –II(Group-B)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Communication Skills in English	HSC	3	3	100	70	20	5	5
2	Mathematics-II	BSC	4	4	100	70	20	5	5
3	Applied Physics	BSC	4	4	100	70	20	5	5
4	Applied Chemistry	BSC	4	4	100	70	20	5	5
	Practical								
5.	Engineering Workshop Practice	ESC	2	4	50	35	5	5	5
6.	Applied Physics Lab	BSC	1	2	50	35	5	5	5
7.	Applied Chemistry Lab	BSC	1	2	50	35	5	5	5
8.	Communication Skills in English Lab	HSC	1	2	50	35	5	5	5
	Total		**20**	**25**	**600**	**420**	**100**	**40**	**40**

SEMESTER-III

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Strength of Materials	PCC	4	4	100	70	20	5	5
2	Material Science & Engineering	PCC	3	3	100	70	20	5	5
3	Fluid Mechanics & Hydraulic Machinery	PCC	4	4	100	70	20	5	5
4	Manufacturing Technology-I	PCC	3	3	100	70	20	5	5
5	Thermal Engineering-I	PCC	3	3	100	70	20	5	5
	Practical								
6	Strength of Materials Lab	PCC	1	2	50	35	5	5	5
7	Fluid Mechanics & Hydraulic Machinery Lab	PCC	1	2	50	35	5	5	5
8	Manufacturing Technology-I Lab	PCC	1	2	50	35	5	5	5
9	Thermal Engineering- I Lab	PCC	1	2	50	35	5	5	5
10	Summer Internship-I(3-4 Weeks)	PROJ	2	0	50	35	15	0	0
	TOTAL		**23**	**25**	**750**	**525**	**135**	**45**	**45**

SEMESTER-IV

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Measurements & Metrology	PCC	3	3	100	70	20	5	5
2	Manufacturing Technology-II	PCC	4	4	100	70	20	5	5
3	Thermal Engineering - II	PCC	4	4	100	70	20	5	5
4	Elective-I Tool Engineering Heat Transfer Farm Equipment & Farm Machinery	PEC	3	3	100	70	20	5	5
5	Elective-II Computer Integrated Manufacturing Refrigeration & Air-conditioning Material Handling Systems	PEC	3	3	100	70	20	5	5
6	Essence of Indian Knowledge Tradition	AC	0	2	50	35	10	2.5	2.5
	Practical								
7	Measurements & Metrology Lab	PCC	1	2	50	35	5	5	5
8	Computer Aided Machine Drawing Practice Lab	PCC	1	2	50	35	5	5	5
9	Manufacturing Technology –II Lab	PCC	1	2	50	35	5	5	5
10	Thermal Engineering– II Lab	PCC	1	2	50	35	5	5	5
11	Minor Project	PROJ	2	4	50	35	15	0	0
	TOTAL		**23**	**31**	**800**	**560**	**145**	**47.5**	**47.5**

SEMESTER V

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory / Practical Exam	Mid Term Theory / Practical Exam	CIA*	Attendance
1	Advanced Manufacturing Processes	PCC	3	3	100	70	20	5	5
2	Theory of Machines & Mechanisms	PCC	3	3	100	70	20	5	5
3	Industrial Engineering & Management	PCC	3	3	100	70	20	5	5
4	Elective-III Computer Aided Design and Manufacturing Automobile Engineering Hybrid Vehicles	PEC	3	3	100	70	20	5	5
5	Elective-IV Industrial Robotics & Automation Power Plant Engineering Mechatronics	PEC	3	3	100	70	20	5	5
6	Open Elective-I Renewable Energy Technology Operation Research Internet of Thing	OEC	3	3	100	70	20	5	5
	PRACTICAL								
7	CAD/CAM Lab	PCC	1	2	100	70	20	5	5
8	Theory of Machines & Mechanisms Lab	PCC	1	2	50	35	5	5	5
9	Summer Internship-II(4-6 Weeks)	PROJ	3	0	100	70	30		
10	Major Project-I (Project to be carried over to next semester)	PROJ	1	2	50	35	15		
	TOTAL		**24**	**24**	**900**	**630**	**190**	**40**	**40**

SEMESTER VI

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory / Practical Exam	CIA*	Attendance
1	Design of Machine Elements	PCC	3	3	100	70	20	5	5
2	Production & Operations Management	PCC	3	3	100	70	20	5	5
3	Entrepreneurship and Start-ups	PROJ	4	4	100	70	20	5	5
4	Open Elective-II Sustainable Development Robotics Artificial Intelligent & Machine Learning	OEC	3	3	100	70	20	5	5
5	Open Elective-III Project Management Product Design Cyber Security Laws, Standards & IPR 3-D Printing	OEC	3	3	100	70	20	5	5
6	Indian Constitution	AC	0	2	50	35	10	2.5	2.5
	PRACTICAL								
7	Seminar	PROJ	1	2	50	35	15	0	0
8	Major Project-II	PROJ	3	0	100	70	30	0	0
	TOTAL		**20**	**20**	**700**	**490**	**155**	**27.5**	**27.5**

Distribution of Credit across 6 semesters:

Sl. No	Type of Paper	No. of Paper	Total Credit
1	Humanities and Social Sciences Courses **(HSC)**	3	7
2	Basic Science courses**(BSC)**	6	18
3	Engineering Science courses **(ESC)**	8	18
4	Professional core courses (**PCC)**	23	53
5	Professional Elective courses**(PEC)**	4	12
6	Open Electives Courses (**OEC)**	3	9
7	Project work, seminar and internship in industry or elsewhere**(PROJ)**	6	12
8	Audit Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]**(AC)**	3	(non-credit)
	Total	56	129

CIA – Continuous Internal Assessment – Based on Projects / Assignment during the semester

Note:

AICTE Activity Points to be earned by students admitted to Diploma program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 3 year Diploma program, is required to earn 75 activity points in addition to the total credits earned for the program. Students entering 3 years Diploma Program through lateral entry are required to earn 50 activity points in addition to the total credits earned for the program.
The activity points earned by the student shall be reflected on the students 6th Semester grade card.
The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled.
Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.
Incase student fail to earn the prescribed activity points, Sixth semester Grade Card shall be issued only after earning the required activity Points.
Students shall be eligible for the award of degree only after the release of the Six Semester grade card.

There are two groups (A & B) in semester 1 & 2. The Group division will be decided by The Dean SoE& IT before commencement of classes*

ARKAJAIN University, Jharkhand
School of Engineering & IT
Department of Engineering
Faculty – Diploma in Mechanical Engineering (DEME)
PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PROGRAM OUTCOMES

After completing this undergraduate program, a learner:

PO.1]. Basic knowledge: An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems

[PO.2]. Discipline knowledge: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.

[PO.3]. Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

[PO.4]. Engineering Tools: Apply appropriate technologies and tools with an understanding of the limitation.

[PO.5]. The engineer and society: Demonstrate knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering practice.

[PO.6]. Environment and sustainability: Understand the impact of the engineering solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development..

[PO.7]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

[PO.8]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse/multidisciplinary teams.

[PO.9]. Communication: An ability to communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.10]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological changes.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Maintenance selection and use of various equipment and machinery and instruments in mechanical processes.

[PSO.2]. Supervise and manage production process and demonstrate a knowledge of management and business practices, such as risk and change management, and understand their limitations.

Subject: Strength of Materials

Code:DIP13100

4 Credits | Semester III

A. Introduction:

- To understand the concept of Simple Stresses and Strains.
- To understand the concept ofStrain Energy.
- To understand the concept of Shear Force and Bending Moment Diagrams.
- To understand the concept of Theory of Simple Bending andDeflectionof Beams.
- To understand the concept of Torsion in Shafts and springs.
- To understand the concept of Thin Cylindrical Shells.

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Remember the definition of stress and strain. Find the changes in axial, lateral and volumetric dimensions

[CO2] Understand the phenomenon of shear force and bending moment and draw the S.F. & B.M diagrams of for UDL and Point loads.

[CO3] Apply various approaches to calculate thermal stresses, in bodies of uniform section and composite sections. Obtain expressions for instantaneous stress developed in bodies subjected to different loads.

[CO4] Analyzethe theory of bending and deflection of beam.

[CO5] Evaluate and Compare strength and weight of solid and hollow shafts of the same length and material and compute the stress and deflection of the closed coil helical spring.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

SIMPLE STRESSES AND STRAINS: Types of forces; Stress, Strain and their nature; Mechanical properties of common engineering materials; Significance of various points on stress – strain diagramfor M.S. and C.I. specimens,Significance of factor of safety; Relation between elastic constants; Stress and

strain values in bodies of uniform section and of composite section under the influence of normal forces; Thermal stresses in bodies of uniform section and composite sections; Related numerical problems on the above topics.Strain energy or resilience, proof resilience and modulus of resilience; Derivation of strain energy for the following cases: i) Gradually applied load, ii) Suddenly applied load, iii) Impact/shock load; Related numerical problems.

SHEAR FORCE & BENDING MOMENT DIAGRAMS: Types of beams, Types of Loads, Definition and explanation of shear force and bending moment,.S.F and B.M. diagrams by the analytical method only for the following cases: a) Cantilever with point loads, b) Cantilever with uniformly distributed load, c) Simply supported beam with point loads, d) Simply supported beam with UDL, e) Over hanging beam with point loads, at the centre and at free ends, f) Over hanging beam with UDL throughout, g) Combination of point and UDL for the above; Related numerical problems.

THEORY OF SIMPLE BENDING AND DEFLECTION OF BEAMS: Explanation of terms: Neutral layer, Neutral Axis, Modulus of Section, Moment of Resistance, Bending stress, Radius of curvature; Assumptions in theory of simple bending, Bending Equation $M/I = \sigma/Y = E/R$ with derivation; Problems involving calculations of bending stress, modulus of section and moment of resistance; Calculation of safe loads and safe span and dimensions of cross- section; Definition and explanation of deflection as applied to beams.Deflection formulae without proof for cantilever and simply supported beams with point load and UDL only (Standard cases only); related numerical problems.

TORSION IN SHAFTS AND SPRINGS: Definition and function of shaft; Calculation of polar M.I. for solid and hollow shafts; Assumptions in simple torsion. Derivation of the equation $T/J=fs/R=G\theta/L$; Problems on design of shaft based on strength and rigidity; Numerical Problems related to comparison of strength and weight of solid and hollow shafts, Classification of springs; Nomenclature of closed coil helical spring; Deflection formula for closed coil helical spring (without derivation); stiffness of spring; Numerical problems on closed coil helical spring to find safe load, deflection, size of coil and number of coils.

THIN CYLINDRICAL SHELLS: Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell, Derivation of expressions for the longitudinal and hoop stress for seamless and seam shells; Related numerical Problems for safe thickness and safe working pressure.

E. TEXT BOOKS

T1. Strength of Materials, R. S. Khurmi, S. Chand & Co., Ram Nagar, New Delhi – 2002
T2. Strength of Materials, D.S. Bedi, Khanna Book Publishing Co., Delhi
T3. Strength of Materials, S. Ramamrutham, 15th Edn 2004, Dhanpat Rai Pub. Co., New Delhi.

F. REFERENCE BOOKS

R1. Strength of Materials ,R.K. Bansal, Laxmi Publications Pvt. Ltd., New Delhi, 3rd Edition,2010.
R2. Strength of Materials, S. S. Rattan, Tata Mcgraw hill, New Delhi, 2008, ISBN 9780070668959

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Remember the definition of stress and strain. Find the changes in axial, lateral and volumetric dimensions	3	2	1								1	1
[CO2]	Understand the phenomenon of shear force and bending moment and draw the S.F. & B.M diagrams of for UDL and Point loads.	2	3	2								1	2
[CO3]	Apply various approaches to calculate thermal stresses, in bodies of uniform section and composite sections. Obtain expressions for instantaneous stress developed in bodies subjected to different loads.	2	2	3								2	2
[CO4]	Analyze the theory of bending and deflection of beam.	1	3	1								1	1
[CO5]	Evaluate and Compare strength and weight of solid and hollow shafts of the same length and material and compute the stress and deflection of the closed coil helical spring.	1	2	1								1	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Material science &Engineering

Code:DIP13174

3 Credits | Semester III

A. Introduction:

- To understand crystal structures and atomic bonds.
- To understand the properties of different types of ferrous metals and alloys.
- To understand the properties of different types of non-ferrous metals and alloys.
- To understand various metallic failures and acquire the knowledge of testing of materials.
- To understand the concept of corrosion and its prevention.

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Understand the crystal structures and atomic bonds. Classification of ferrous metals and their properties

[CO2] Describe non-ferrous metals, cutting tool materials and composites along with their properties. Principle of corrosion, their types and its prevention methods along with the various surface engineering processes.

[CO3] Apply various parameters to understand the properties and compositions of materials.

[CO4] Analyze the various phase diagrams of ferrous metals and alloys, composition and use of non-ferrous metals.

[CO5] Evaluate different methods of failure analysis and testing of materials.

C. Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

CRYSTAL STRUCTURES AND BONDS: Unit cell and space lattice: Crystal system: The seven basic crystal systems; Crystal structure for metallic elements: BCC, FCC and HCP,Coordination number for Simple Cubic, BCC and FCC; Atomic radius: definition, atomic radius for Simple Cubic, BCC and FCC; Atomic Packing Factor for Simple Cubic, BCC, FCC and HCP,Simple problems on finding number of atoms for a unit cell.Bonds in solids:Classification - primary or chemical bond, secondary or molecular bond; Types of primary bonds: Ionic, Covalent and Metallic Bonds; Types of secondary bonds: Dispersion bond, Dipole bond and Hydrogen bond.

PHASE DIAGRAMS, FERROUS METALS AND ITS ALLOYS: Isomorphs, eutectic and eutectoid systems.Iron-Carbon binary diagram; Iron and Carbon Steels; flow sheet for production of iron and steel; Iron ores – Pig iron: classification, composition and effects of impurities on iron; Cast Iron: classification, composition, properties and uses; Wrought Iron: properties, uses/applications of wrought Iron; comparison of cast iron, wrought iron and mild steel and high carbon steel; standard commercial grades of steel as per BIS and AISI.Alloy Steels – purpose of alloying; effects of alloying elements– Important alloy steels: Silicon steel, High Speed Steel (HSS), heat resisting steel, spring steel, Stainless Steel (SS): types of SS, applications of SS – magnet steel – composition, properties and uses.

NON-FERROUS METALS AND ITS ALLOYS: Properties and uses of aluminum, copper, tin, lead, zinc, magnesium and nickel, Copper alloys: Brasses, bronzes – composition, properties and uses; Aluminum alloys: Duralumin, hindalium, magnesium – composition, properties and uses; Nickel alloys: Inconel, Monel, nicPerome – composition, properties and uses.Anti-friction/Bearing alloys: Various types of bearing bronzes - Standard commercial grades as per BIS/ASME.

FAILURE ANALYSIS & TESTING OF MATERIALS: Introduction to failure analysis; Fracture: ductile fracture, brittle fracture; cleavage; notch sensitivity. fatigue; endurance limit; characteristics of fatigue fracture; variables affecting fatigue life; creep; creep curve; creep fracture. Destructive testing: Tensile testing; compression testing; Hardness testing: Brinell, Rockwell; bend test; torsion test; fatigue test; creep test. Non-destructive testing: Visual Inspection; magnetic particle inspection; liquid penetrant test; ultrasonic inspection; radiography.

CORROSION & SURFACE ENGINEERING: Nature of corrosion and its causes; Electrochemical reactions; Electrolytes; Factors affecting corrosion: Environment, Material properties and physical conditions; Types of corrosion; Corrosion control: Material selection, environment control and design.Surface engineering processes: Coatings and surface treatments; Cleaning and mechanical finishing of surfaces; Organic coatings; Electroplating and Special metallic plating;Electro polishing and photo- etching ;– Conversion coatings: Oxide, phosphate and chromate coatings; Thin film coatings: PVD and CVD; Surface analysis; Hard-facing, thermal spraying and high-energy processes; Process/material selection. Pollution norms for treating effluents as per standards.

E. TEXT BOOKS

T1.A Text Book of Material Science & Metallurgy – O.P. Khanna, Dhanpath Rai and Sons, New Delhi. 2003.
T2.Material Science & Engineering – R.K. Rajput, S.K. Kataria& Sons, New Delhi, 2004.

F. REFERENCE BOOKS

.R1.Material Science – R.S. Khurmi, S. Chand & Co. Ltd., New Delhi, 2005.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Understand the crystal structures and atomic bonds. Classification of ferrous metals and their properties	3	2	1								1	1
[CO2]	Describe non-ferrous metals, cutting tool materials and composites along with their properties. Principle of corrosion, their types and its prevention methods along with the various surface engineering processes.	1	2		3							1	1
[CO3]	Apply various parameters to understand the properties and compositions of materials.	1	2	1								1	2
[CO4]	Analyze the various phase diagrams of ferrous metals and alloys, composition and use of non-ferrous metals.	1	2	2								2	2
[CO5]	Evaluate different methods of failure analysis and testing of materials.		2	3	2							1	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Fluid Mechanics & Hydraulic Machinery

Code:

4 Credits | Semester III

A. Introduction:

- To understand fluid flow & related machinery for power generation, water supply and irrigation.
- To Select and use appropriate flow measuring device.
- To Select and use appropriate pressure measuring device.
- To understand and analyze the performance of pumps and turbines.

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Remember various properties of fluids in solving the problems.
[CO2]Understand working of Impact of Jet, pumps and turbines.
[CO3]Apply Bernoulli's equation for solutions in fluids
[CO4]Analyse fluid forces - drags and lift on immersed bodies
[CO5] Evaluate the dimensionless parameters

C. Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS:

PROPERTIES OF FLUID AND PRESSURE MEASUREMENT: Density, Specific gravity, Specific Weight, Specific Volume, Dynamic Viscosity, Kinematic Viscosity, Surface tension, Capillarity, Vapour Pressure, Compressibility.**Fluid Pressure & Pressure Measurement:** Fluid pressure, Pressure head, Pressure intensity, Concept of vacuum and gauge pressures, atmospheric pressure, absolute pressure, Simple and differential manometers, Bourdon pressure gauge,Concept of Total pressure on immersed bodies, center of pressure, Simple problems on Manometers.

FLUID FLOW: Types of fluid flows, Path line and Stream line, Continuity equation, Bernoulli's theorem, Principle of operation of Venturimeter, Orifice meter and Pitot tube, Derivations for discharge, coefficient of discharge and numerical problems,Laminar and turbulent flows; Darcy's equation and Chezy's equation for frictional losses, Minor losses in pipes, Hydraulic gradient and total gradient line.Numerical problems to estimate major and minor losses.

IMPACT OF JETS: Impact of jet on fixed vertical, moving vertical flat plates, Impact of jet on curved vanes with special reference to turbines &pumps,Simple Numerical on work done and efficiency.

HYDRAULIC TURBINES: Layout of hydroelectric power plant, Features of Hydroelectric power plant, Classification of hydraulic turbines, Selection of turbine on the basis of head and discharge available. Construction and working principle of Pelton wheel, Francis and Kaplan turbines.Draft tubes – types and construction, Concept of cavitations in turbines, Calculation of Work done, Power, efficiency of turbines, Unit quantities and simple numerical.

CENTRIFUGAL PUMPS AND RECIPROCATING PUMPS: Principle of working and applications, Types of casings and impellers, Concept of multistage, Priming and its methods, Cavitation.Manometric head, Work done, Manometricefficiency, Overall efficiency. Numericals on calculations of overall efficiency and power required to drive pumps.**Reciprocating Pumps:** Construction, working principle and applications of single and double acting reciprocating pumps, Concept of Slip, Negative slip, Cavitation and separation.

E. TEXT BOOKS

T1.Fluid Mechanics & Hydraulic Machines, S.S. Rattan, Khanna Publishing House, New Delhi
T2.Hydraulic, fluid mechanics & fluid machines – Ramamrutham S, Dhanpath Rai and Sons, NewDelhi.
T3.Hydraulics and fluid mechanics including Hydraulic machines – Modi P.N. and Seth S.M. Standard Book House. New Delhi
T4.One Thousand Solved Problems in Fluid Mechanics – K. Subramanya, Tata McGraw Hill.

F. REFERENCE BOOKS

R1.Hydraulic, fluid mechanics & fluid machines – S. Ramamrutham, Dhanpat Rai and Sons, NewDelhi
R2.Fluid Mechanics and Hydraulic Machines – R. K. Bansal, Laxmi Publications, New Delhi

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Remember various properties of fluids in solving the problems.	1	3	1								1	1
[CO2]	Understand working of Impact of Jet, pumps and turbines.	1	3	2								2	2
[CO3]	Apply Bernoulli's equation for solutions in fluids	1	2	3								2	1
[CO4]	Analyse fluid forces - drags and lift on immersed bodies	1	2	1								1	1
[CO5]	Evaluate the dimensionless parameters	1	3	1								1	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Manufacturing Technology-I

Code:DIP14110

3 Credits | Semester III

A. INTRODUCTION:

- To study various types of basic production processes
- To study various metal forming processes.
- To study and understand sand casting process and various terminologies used in casting.
- To understand various welding processes.

B. COURSE OUTCOMES: By the end of this course, students will be able to:

[CO 1]Adopt safety practices while working on various machines.
[CO 2] Understand the basic manufacturing processes for manufacturing different components.
[CO 3] Apply the specific manufacturing process for getting the desired type of output.
[CO 4] Analyze the process of casting, forging and weldingrequired for specific condition.
[CO 5]Evaluate the entire manufacturing process involved in manufacturing components.

C. ASSESSMENT PLAN:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS:

CASTING: Patterns-Material used, types, Patterns allowances, Cores, Core allowances. Moulds-Mould materials, Types of sand ,Mounding processes Sand moulding ,Pit moulding, machine moulding .Shell moulding.Melting practice. Types of furnaces with specific applicationCupola furnace, Electric arc furnace. Casting principle and operation,Special casting processes. viz die casting, centrifugal casting, Investment casting. Casting defects

FORGING: Forging Processes–Drop forging, Upset forging ,Die forging or press forging.Types of dies-Open Die, Closed Die(Single Impression and Multi-impression) Closed die Forging operations- Fullering ,Edging, Bending, Blocking, Finishing,Forge able material and forge ability, Forging temperature, Grain flow in forged parts, Types of Press sand hammers.

.

ROLLING AND EXTRUSION: Principles of rolling and extrusion. Hot and cold rolling.Types of rolling mills Different sections of rolled parts, Methods of extrusion–Direct ,Indirect ,backward &impact Extrusion, Hot extrusion, Cold extrusion Advantages, disadvantages and applications.

PRESS WORKING: Types of presses and Specifications.Press working operations- Cutting, bending ,drawing, punching, blanking, notching, lancing, Die set components. -punch and die shoe, guide pin, bolster plate,stripper, stock guide ,feedstock ,pilot.Punch and die Clearances for blank in gland piercing, effect of clearance.

WELDING: Classification. Gas welding techniques.Types of welding flames. Arc Welding–Principle, Equipment, ApplicationsShielded metal arc welding. Sub merged arc welding. TIG/MIG welding. Resistance welding- Spot welding, Seam welding, Projection welding, Welding defects. Brazing and soldering: Types, Principles, Applications

E. TEXT BOOKS

T1.Elements of workshop Technology –Volume I & II, S. K. HajraChaudary, Bose& Roy, Media Promoter sand Publishers limited.
T2.Production Technology-Volume I&II, O. P.Khanna and Lal.

F. REFERENCE BOOKS

R1.Introduction to Manufacturing Processes, Jhon A Schey, Mc Graw Hills International
R2.Manufacturing Technology, M. Aduthan and A.B. Gupta, New Age International

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Adopt safety practices while working on various machines.		2			2					2	1	1
[CO2]	Understand the basic manufacturing processes for manufacturing different components.	1	2	1								1	1
[CO3]	Apply the specific manufacturing process for getting the desired type of output.	1	3	1								1	1
[CO4]	Analyze the process of casting, forging and welding required for specific condition.		2	2	2							2	2
[CO5]	Evaluate the entire manufacturing process involved in manufacturing components.		3	2	1							2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject:Thermal Engineering-I

Code:DIP13179

3 Credits | Semester III

A. INTRODUCTION:

- To give a good understanding of and thorough insight into all important aspects of thermal systems, energy control and the general issue of energy.
- To understand the principles & working of various power producing & power absorbing devices.
- To study, analyze and evaluate the operation and the performance of I.C. engines, compressors and refrigerators.
- To apply pinch technology and to critically analyze and describe the global behavior of integrated thermal systems.

B. COURSE OUTCOMES: By the end of this course, students will be:

[CO1] Identify the various sources of Energy and their applications.
[CO2] Understandthe working and constructional features of I.C. engines, Air compressor, Refrigerator, Air conditioner.
[CO3] Apply various practical power cycles and heat pump cycles.
[CO4]Analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.
[CO5]Evaluate the Performance of IC engines, Compressor, Refrigerator, Air Conditioning systems.

C. ASSESSMENT PLAN:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS:

SOURCES OF ENERGY: Brief description of energy Sources: Classification of energy sources - Renewable, Non-Renewable; Fossil fuels, including CNG, LPG.Solar Energy: Flat plate and concentrating collectors & its applications (Solar Water Heater, Photovoltaic Cell, Solar Distillation).Wind Energy; Tidal Energy; Ocean Thermal Energy; Geothermal Energy; Biogas, Biomass, Bio-diesel; Hydraulic Energy, Nuclear Energy; Fuel cell.

INTERNAL COMBUSTION ENGINES: Assumptions made in air standard cycle analysis; Brief description of Carnot, Otto and Diesel cycles with P-V and T-S diagrams. Internal and external combustion engines. classification of I.C. engines; neat sketch of I.C. engine indicating component parts; Function of each part and materials used for the component parts - Cylinder, crank case, crank pin, crank,

crank shaft, connecting rod, wrist pin, piston, cooling pins cylinder heads, exhaust valve, inlet valve.Working of four-stroke and two-stroke petrol and diesel engines; Comparison of two stroke and four stroke engines; Comparison of C.I. and S.I. engines; Valve timing and port timing diagrams for four stroke and two stroke engines.

I.C. ENGINE SYSTEMS: Fuel system of Petrol engines; Principle of operation of simple and Zenith carburettors; Fuel system of Diesel engines; Types of injectors and fuel pumps. Cooling system - air cooling, water cooling system with thermo siphon method of circulation and water cooling system with radiator and forced circulation (description with line diagram). Comparison of air cooling and water cooling system.Ignition systems – Battery coil ignition and magneto ignition (description and working). Comparison of two systems; Types of lubricating systems used in I.C. engines with line diagram; Types of governing of I.C. engines – hit and miss method, quantitative method, qualitative method and combination methods of governing; their applications; Objective of super charging.

PERFORMANCE OF I.C. ENGINES: Brake power; Indicated power; Frictional power; Brake and Indicated mean effective pressures; Brake and Indicated thermal efficiencies; Mechanical efficiency; Relative efficiency. Performance test; Morse test; Heat balance sheet; Methods of determination of B,P., I.P. and F.P. Simple numerical problems on performance of I.C. engines.

AIR COMPRESSORS, REFRIGERATION & AIR-CONDITIONING: Types of air compressors; Single stage reciprocating air compressor - its construction and working (with line diagram) using P-V diagram; Multi stage compressors – Advantages over single stage compressors; Rotary compressors: Centrifugal compressor, axial flow type compressor and vane type compressors.Refrigeration; Refrigerant; COP; Air Refrigeration system: components, working & applications; Vapour Compression system: components, working &applications.Air conditioning; Classification of Air-conditioning systems; Comfort and Industrial Air-Conditioning; Window Air-Conditioner; Summer Air-Conditioning system, Winter Air-Conditioning system, Year-round Air-Conditioning system.

E. TEXT BOOKS

T1.Introduction to Renewable Energy – Vaughn Nelson, CRC Press
T2.Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002
T3.A Course in Thermal Engineering – S. Domkundwar& C.P. Kothandaraman, Dhanpat Rai.

F. REFERENCE BOOKS

R1.Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, NewDelhi.
R2.Thermal Engineering – R. K. Rajput, 8th Edition, Laxmi publications Pvt Ltd, New Delhi.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Identify the various sources of Energy and their applications.	1	2									1	1
[CO2]	Understand the working and constructional features of I.C. engines, Air compressor, Refrigerator, Air conditioner.	1	3		1							2	2
[CO3]	Apply various practical power cycles and heat pump cycles.		3	2	2							2	1
[CO4]	Analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.		3	2	2							2	2
[CO5]	Evaluate the Performance of IC engines, Compressor, Refrigerator, Air Conditioning systems		3	2								2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Strength of Materials Lab

Code:DIP13104

1 Credits | Semester III

A. Introduction:

- To identify the type of stress developed in materials.
- To study the effect of stress in materials such as elongation, strain and energy stored in material.
- To understand different point on stress strain curve.
- To understand various material testing methods to determine mechanical properties such as yield stress, Ultimate stress, percentage elongation, Young's Modulus etc.
- To understand effect of bending and torsion in mechanical components.

B. **Course Outcomes:** At the end of the course, students will be able to

[CO 1] Determine the various types of stress induced in specimen.
[CO 2] Plot the stress strain diagram for mild steel and other general used materials.
[CO 3] Conduct and measure different types of hardness of metals.
[CO 4] Determine the torsion, bending, impact and shear values of given materials
[CO 5] Determine the modulus of rigidity, strain energy, shear stress and stiffness of coil spring.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

S.No.	Topics for practice
1	Determination of Rockwell's Hardness Number for various materials like mild steel, high carbon steel, brass, copper and aluminum.
2	Determination of Brinell's Hardness Number for various materials like mild steel, high carbon steel, brass, copper and aluminum.
3	Finding the resistance of materials to impact loads by Izodtest .

4	Finding the resistance of materials to impact loads by Charpy test.
5	Torsion test on mild steel – relation between torque and angle of twist determination of shear modulus and shear stress.
6	Finding Young's Modulus of Elasticity, yield points, percentage elongation and percentage reduction in area, stress strain diagram plotting, tests on mild steel.
7	Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Open & Closed coil spring)
8	Single or double Shear test on M.S. bar to finding the resistance of material to shear load.
9	To Determine tensile test using UTM
10	To Determine Bending , shear and compression test using UTM

E. Text Book:

T1. Measurement system (Application and Design) – Ernest O Doebelin.
T2. Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi

F. Reference Books:

R1. A Text Book strength of Material– R.K. Bansal, Laxmi Publication New Delhi

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Determine the various types of stress induced in specimen.		2	3	2							1	1
[CO2]	Plot the stress strain diagram for mild steel and other general used materials.	1	3	3									1
[CO3]	Conduct and measure different types of hardness of metals.		2	3	3							3	2
[CO4]	Determine the torsion, bending, impact and shear values of given materials		2	3	3							3	2
[CO5]	Determine the modulus of rigidity, strain energy, shear stress and stiffness of coil spring.		1	3	2							2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Fluid Mechanics & Hydraulic Machinery Lab

Code:

- Credits | Semester III

A. Introduction:

- To calibrate the given flow measuring device.
- To apply the knowledge acquired in theory subject.
  To analyses the performance of turbines and pumps

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Measure various properties such as pressure, velocity and flow rate using various instruments.
[CO 2] Calculate different parameters such as co-efficient of friction, power, efficiency etc. of various systems.
[CO 3] Understand the need and importance of calibration of pressure gauges.
[CO 4] Describe the construction and working of turbines.
[CO 4] Understand the losses of flow through pipes.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D.SYLLABUS

S.No.	Topics for practice
1	Verification of Bernoulli's theorem.
2	Determination of Coefficient of Discharge of Venturimeter.
3	Determination of Coefficient of Discharge, coefficient of contraction and coefficient ofvelocity of Orificemeter.
4	Determination of coefficient of friction of flow through pipes.
5	Determination of force exerted by the jet of water on the given vane.

6	Determination of minor losses of flow through pipes.
7	Calibration of pressure gauge using dead weight pressure gauge tester.
8	Trial on centrifugal pump to determine overall efficiency.
9	Trial on reciprocating pump to determine overall efficiency.
10	Trial on Pelton wheel to determine overall efficiency.
11	Trial on Francis/Kaplan turbine to determine overall efficiency.

E. TEXT BOOKS

T1.Fluid Mechanics & Hydraulic Machines, S.S. Rattan, Khanna Publishing House, New Delhi
T2.Hydraulic, fluid mechanics & fluid machines – Ramamrutham S, Dhanpath Rai and Sons, NewDelhi.
T3.Hydraulics and fluid mechanics including Hydraulic machines – Modi P.N. and Seth S.M. Standard Book House. New Delhi
T4.One Thousand Solved Problems in Fluid Mechanics – K. Subramanya, Tata McGraw Hill.

F. REFERENCE BOOKS

R1.Hydraulic, fluid mechanics & fluid machines – S. Ramamrutham, Dhanpat Rai and Sons, NewDelhi
R2.Fluid Mechanics and Hydraulic Machines – R. K. Bansal, Laxmi Publications, New Delhi

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Measure various properties such as pressure, velocity and flow rate using various instruments.		2	3	2							2	2
[CO2]	Calculate different parameters such as co-efficient of friction, power, efficiency etc. of various systems.		2	2	2							2	1
[CO3]	Understand the need and importance of calibration of pressure gauges.		2	2	2							3	2
[CO4]	Describe the construction and working of turbines.		3	3	2							3	3
[CO5]	Understand the losses of flow through pipes.	1	2	3								2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Manufacturing Technology-ILab

Code:
1 Credits | Semester III

A. Introduction:

- To Practice the casting principles and operations in foundry.
- To Practice sheet metal operations.
- To practice different metal forming processes.
- To Practice the joining of metals using different Welding techniques.

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Prepare a mould sand mix and molten metal and calculate the amount of metal to be poured in the mould.
[CO 2] Prepare the edges for welding and select the suitable electrode, voltage and current.
[CO 3] Operate the welding transformer and generator to perform various weld joint operations.
[CO 4] Understand the different metal forming tools and their uses.
[CO 5] Understand the sheet metal working and development of surfaces by sheet metal.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D.SYLLABUS

S.No.	Topics for practice
1	Moulding& casting of (i) Connecting rod (ii) Solid bearing (iii) V-Pulley/Gear Pulley
2	Preparation of two piece patterns, cope and drag patterns, gated patterns etc.

3	Arc welding (i) Lap Joint (ii) Butt Joint (iii) T- Joint
4	Study of straight polarity and reverse polarity on quality of weld.
5	Gas welding (i) Lap Joint (ii) Butt Joint
6	Spot welding (i) Lap Joint
7	Simple products by sheet metal working such as ducts of T- shape.
8	Open die forging of mild steel to prepare chisel, hexagonal rods etc.

E. Text Book:

T1. Elements of Workshop Technology (Volume I & II) – HajraChowdry&Bhattacharaya, Media Promoters, 11th Edition, 2007

T2. Introduction of Basic Manufacturing Processes and Workshop Technology – Rajendersingh, New age International (P) Ltd. NewDelhi, 2006

T3. Workshop Technology – Raghuwanshi, Khanna Publishers. Jain &Gupta, New Delhi, 2002

T4. Production Technology – Jain & Gupta, Khanna Publishers, New Delhi, 2006.

F. Reference Books:

R1. Production Technology – HMT, 18th edition, Tata McGraw Hill, New Delhi

R2. Manufacturing process – Myro N Begman, 5 th edition, Tata McGraw Hill, New Delhi

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Prepare a mould sand mix and molten metal and calculate the amount of metal to be poured in the mould.		2	3	2							2	1
[CO2]	Prepare the edges for welding and select the suitable electrode, voltage and current.		2	2	2							2	2
[CO3]	Operate the welding transformer and generator to perform various weld joint operations.		2	3	2							3	2
[CO4]	Understand the different metal forming tools and their uses.		1	2	3							2	1
[CO5]	Understand the sheet metal working and development of surfaces by sheet metal.		2	2	2							2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Thermal Engineering I Lab

Code: DIP13178

1 Credits | Semester III

A. Introduction:

- To understand the importance of fuel properties and learn the methods of determination of various properties of fuels.
- To understand the working principles of various methods used in determination of properties of fuels.
- To observe different parts of I.C. engine and understand their working.
- To identify the physical differences between S.I. and C.I. engines and 2-S and 4-S engines.

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Understand the functions of various parts of IC engines and the working of IC engines.
[CO 2] Understand the determination of Calorific value of a given sample of fuel using given apparatus.
[CO 3] Understand the determination of amount of carbon residue of a given sample of petroleum product.
[CO 4]Draw VTD /PTD of given I.C. Engine and understand how the processes are controlled during its operation.
[CO 5] Understand the working of two stroke and four stroke I. C. Engines.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

Sl. No.	Topics for practice
1	Study of petrol and diesel engine components and Models
2	To conduct performance test and retardation test on 4 stroke single cylinder diesel engine.

3	To conduct performance test and retardation test on 4 stroke Twin cylinder diesel engine.
4	To conduct performance test on 4 stroke single cylinder diesel engine at different varying load and at constant speed.
5	To conduct Morse test on a 4-stroke multi cylinder petrol engine at different speed to calculate frictional power.
6	Calorific value tests using Bomb Calorimeter (Solid and Liquid fuels) and Junkers Gas Calorimeter (Gaseous fuels).
7	Port timing diagram of Petrol engine
8	Port timing diagram of Diesel engine
9	Valve timing diagram of Petrol engine
10	Valve timing diagram of Diesel engine

E. Text Book:

T1.Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002

T2.A Course in Thermal Engineering – S. Domkundwar& C.P. Kothandaraman, Dhanpat Rai &Publication New Delhi

F. Reference Books:

T3.Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, NewDelhi

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Understand the functions of various parts of IC engines and the working of IC engines.	1	2									1	1
[CO2]	Understand the determination of Calorific value of a given sample of fuel using given apparatus.		2	3	2							2	2
[CO3]	Understand the determination of amount of carbon residue of a given sample of petroleum product.		2	2	2							2	1
[CO4]	Draw VTD /PTD of given I.C. Engine and understand how the processes are controlled during its operation.	1	2	3								2	1
[CO5]	Understand the working of two stroke and four stroke I. C. Engines.	2	3	2								3	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject:Summer Internship-1(3-4 Weeks)

Code: DIP13177

2 Credits | Semester III

A. Introduction:

- Following are the intended objectives of internship training:
- Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Experience gained from the 'Industrial Internship' in classroom will be use in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job

GUIDELINES FOR INTERNSHIP

Summer Internship -1 should be undertaken in an industry/Govt. or Pvt. Certified Agencies which are in social sector/ Govt. Skill Centres/Institutes/Schemes.

S.No.	Suggested Schedule	Suggested Duration (In weeks)	Activities
1	Summer/winter vacation after 2nd/3rd Semester	3-4	Inter/Intra Institutional Activities

ARKA JAIN University
Jharkhand

Syllabus of

Diploma in Mechanical Engineering

Semester-IV

ARKAJAIN University, Jharkhand
School of Engineering & IT
Department of Engineering
Faculty – Diploma in Mechanical Engineering (DEME)
Scheme of Study (w.e.f Batch 2020-23)

SEMESTER –I (Group-A)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Communication Skills in English	HSC	3	3	100	70	20	5	5
2	Mathematics-I	BSC	4	4	100	70	20	5	5
3	Applied Physics	BSC	4	4	100	70	20	5	5
4	Applied Chemistry	BSC	4	4	100	70	20	5	5
	Practical								
5.	Engineering Workshop Practice	ESC	2	4	50	35	5	5	5
6.	Applied Physics Lab	BSC	1	2	50	35	5	5	5
7.	Applied Chemistry Lab	BSC	1	2	50	35	5	5	5
8.	Communication Skills in English Lab	HSC	1	2	50	35	5	5	5
	Total		**20**	**25**	**600**	**420**	**100**	**40**	**40**

SEMESTER I (Group-B)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Mathematics -I	BSC	4	4	100	70	20	5	5
2	Fundamentals of Electrical & Electronics Engg.	ESC	4	4	100	70	20	5	5
3	Introduction to IT system	ESC	3	3	100	70	20	5	5
4	Engineering Mechanics	ESC	4	4	100	70	20	5	5
5	Environmental Science	AC	0	2	50	35	10	2.5	2.5
	Practical								
6	Fundamentals of electrical & electronics Engg. Lab	ESC	1	2	50	35	5	5	5
7	Introduction to IT system Lab	ESC	1	2	50	35	5	5	5
8	Engineering Mechanics Lab	ESC	1	2	50	35	5	5	5
9	Engineering Graphics	ESC	2	4	50	35	5	5	5
	Total		**20**	**27**	**650**	**455**	**110**	**42.5**	**42.5**

SEMESTER II (Group-A)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Mathematics -II	BSC	4	4	100	70	20	5	5
2	Fundamentals of Electrical & Electronics Engg.	ESC	4	4	100	70	20	5	5
3	Introduction to IT system	ESC	3	3	100	70	20	5	5
4	Engineering Mechanics	ESC	4	4	100	70	20	5	5
5	Environmental Science	AC	0	2	50	35	10	2.5	2.5
	Practical								
6	Fundamentals of electrical & electronics Engg. Lab	ESC	1	2	50	35	5	5	5
7	Introduction to IT system Lab	ESC	1	2	50	35	5	5	5
8	Engineering Mechanics Lab	ESC	1	2	50	35	5	5	5
9	Engineering Graphics	ESC	2	4	50	35	5	5	5
	Total		**20**	**27**	**650**	**455**	**110**	**42.5**	**42.5**

SEMESTER –II(Group-B)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Communication Skills in English	HSC	3	3	100	70	20	5	5
2	Mathematics-II	BSC	4	4	100	70	20	5	5
3	Applied Physics	BSC	4	4	100	70	20	5	5
4	Applied Chemistry	BSC	4	4	100	70	20	5	5
	Practical								
5.	Engineering Workshop Practice	ESC	2	4	50	35	5	5	5
6.	Applied Physics Lab	BSC	1	2	50	35	5	5	5
7.	Applied Chemistry Lab	BSC	1	2	50	35	5	5	5
8.	Communication Skills in English Lab	HSC	1	2	50	35	5	5	5
	Total		**20**	**25**	**600**	**420**	**100**	**40**	**40**

SEMESTER-III

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Strength of Materials	PCC	4	4	100	70	20	5	5
2	Material Science & Engineering	PCC	3	3	100	70	20	5	5
3	Fluid Mechanics & Hydraulic Machinery	PCC	4	4	100	70	20	5	5
4	Manufacturing Technology-I	PCC	3	3	100	70	20	5	5
5	Thermal Engineering-I	PCC	3	3	100	70	20	5	5
	Practical								
6	Strength of Materials Lab	PCC	1	2	50	35	5	5	5
7	Fluid Mechanics & Hydraulic Machinery Lab	PCC	1	2	50	35	5	5	5
8	Manufacturing Technology-I Lab	PCC	1	2	50	35	5	5	5
9	Thermal Engineering- I Lab	PCC	1	2	50	35	5	5	5
10	Summer Internship-I(3-4 Weeks)	PROJ	2	0	50	35	15	0	0
	TOTAL		**23**	**25**	**750**	**525**	**135**	**45**	**45**

SEMESTER-IV

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Measurements & Metrology	PCC	3	3	100	70	20	5	5
2	Manufacturing Technology-II	PCC	4	4	100	70	20	5	5
3	Thermal Engineering - II	PCC	4	4	100	70	20	5	5
4	Elective-I Tool Engineering Heat Transfer Farm Equipment & Farm Machinery	PEC	3	3	100	70	20	5	5
5	Elective-II Computer Integrated Manufacturing Refrigeration & Air-conditioning Material Handling Systems	PEC	3	3	100	70	20	5	5
6	Essence of Indian Knowledge Tradition	AC	0	2	50	35	10	2.5	2.5
	Practical								
7	Measurements & Metrology Lab	PCC	1	2	50	35	5	5	5
8	Computer Aided Machine Drawing Practice Lab	PCC	1	2	50	35	5	5	5
9	Manufacturing Technology –II Lab	PCC	1	2	50	35	5	5	5
10	Thermal Engineering– II Lab	PCC	1	2	50	35	5	5	5
11	Minor Project	PROJ	2	4	50	35	15	0	0
	TOTAL		**23**	**31**	**800**	**560**	**145**	**47.5**	**47.5**

SEMESTER V

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory / Practical Exam	Mid Term Theory / Practical Exam	CIA*	Attendance
1	Advanced Manufacturing Processes	PCC	3	3	100	70	20	5	5
2	Theory of Machines & Mechanisms	PCC	3	3	100	70	20	5	5
3	Industrial Engineering & Management	PCC	3	3	100	70	20	5	5
4	Elective-III Computer Aided Design and Manufacturing Automobile Engineering Hybrid Vehicles	PEC	3	3	100	70	20	5	5
5	Elective-IV Industrial Robotics & Automation Power Plant Engineering Mechatronics	PEC	3	3	100	70	20	5	5
6	Open Elective-I Renewable Energy Technology Operation Research Internet of Thing	OEC	3	3	100	70	20	5	5
	PRACTICAL								
7	CAD/CAM Lab	PCC	1	2	100	70	20	5	5
8	Theory of Machines & Mechanisms Lab	PCC	1	2	50	35	5	5	5
9	Summer Internship-II(4-6 Weeks)	PROJ	3	0	100	70	30		
10	Major Project-I (Project to be carried over to next semester)	PROJ	1	2	50	35	15		
	TOTAL		**24**	**24**	**900**	**630**	**190**	**40**	**40**

SEMESTER VI

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory / Practical Exam	CIA*	Attendance
1	Design of Machine Elements	PCC	3	3	100	70	20	5	5
2	Production & Operations Management	PCC	3	3	100	70	20	5	5
3	Entrepreneurship and Start-ups	PROJ	4	4	100	70	20	5	5
4	Open Elective-II Sustainable Development Robotics Artificial Intelligent & Machine Learning	OEC	3	3	100	70	20	5	5
5	Open Elective-III Project Management Product Design Cyber Security Laws, Standards & IPR 3-D Printing	OEC	3	3	100	70	20	5	5
6	Indian Constitution	AC	0	2	50	35	10	2.5	2.5
	PRACTICAL								
7	Seminar	PROJ	1	2	50	35	15	0	0
8	Major Project-II	PROJ	3	0	100	70	30	0	0
	TOTAL		**20**	**20**	**700**	**490**	**155**	**27.5**	**27.5**

Distribution of Credit across 6 semesters:

Sl. No	Type of Paper	No. of Paper	Total Credit
1	Humanities and Social Sciences Courses **(HSC)**	3	7
2	Basic Science courses**(BSC)**	6	18
3	Engineering Science courses **(ESC)**	8	18
4	Professional core courses (**PCC)**	23	53
5	Professional Elective courses**(PEC)**	4	12
6	Open Electives Courses (**OEC)**	3	9
7	Project work, seminar and internship in industry or elsewhere**(PROJ)**	6	12
8	Audit Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]**(AC)**	3	(non-credit)
	Total	56	129

CIA – Continuous Internal Assessment – Based on Projects / Assignment during the semester

Note:

AICTE Activity Points to be earned by students admitted to Diploma program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 3 year Diploma program, is required to earn 75 activity points in addition to the total credits earned for the program. Students entering 3 years Diploma Program through lateral entry are required to earn 50 activity points in addition to the total credits earned for the program.
The activity points earned by the student shall be reflected on the students 6th Semester grade card.
The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled.
Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.
Incase student fail to earn the prescribed activity points, Sixth semester Grade Card shall be issued only after earning the required activity Points.
Students shall be eligible for the award of degree only after the release of the Six Semester grade card.

There are two groups (A & B) in semester 1 & 2. The Group division will be decided by The Dean SoE& IT before commencement of classes*

ARKAJAIN University, Jharkhand
School of Engineering & IT
Department of Engineering
Faculty – Diploma in Mechanical Engineering (DEME)
PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PROGRAM OUTCOMES

After completing this undergraduate program, a learner:

PO.1]. Basic knowledge: An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems

[PO.2]. Discipline knowledge: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.

[PO.3]. Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

[PO.4]. Engineering Tools: Apply appropriate technologies and tools with an understanding of the limitation.

[PO.5]. The engineer and society: Demonstrate knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering practice.

[PO.6]. Environment and sustainability: Understand the impact of the engineering solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development..

[PO.7]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

[PO.8]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse/multidisciplinary teams.

[PO.9]. Communication: An ability to communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.10]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological changes.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Maintenance selection and use of various equipment and machinery and instruments in mechanical processes.

[PSO.2]. Supervise and manage production process and demonstrate a knowledge of management and business practices, such as risk and change management, and understand their limitations.

Subject: Measurements &Metrology

Code: DIP14201

3 Credits | Semester IV

A. Introduction:

- To study advances in technology, measurement techniques, types of instrumentation devices, innovations, refinements.
- To study the principles of instrumentation, transducers & measurement of non-electrical parameters like temperature, pressure, flow, speed, force, and stress.

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in metrology.

[CO2] Distinguish between various types of errors.

[CO3] Understand the principle of operation of an instrument and select suitable measuring device for a particular application.

[CO4]Explain the concept of calibration of an instrument.

[CO5] Analyze and interpret the data obtained from the different measurements processes and present it in the graphical form, statistical form.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

INTRODUCTION TO MEASUREMENTS: Definition of measurement; Significance of measurement; Methods of measurements: Direct & Indirect; Generalized measuring system, Standards of measurements: Primary & Secondary; Factors influencing selection of measuring instruments; Terms applicable to measuring instruments, Precision and Accuracy, Sensitivity and Repeatability, Range, Threshold, Hysteresis, calibration; Errors in Measurements: Classification of errors, Systematic, and Random error. Measuring instruments: Introduction; Thread measurements: Thread gauge micrometer; Angle measurements: Bevel protractor, Sine Bar; Gauges: plain plug gauge, ring Gauge, snap gauge, limit gauge; Comparators: Characteristics of comparators, Types of comparators; Surface finish: Definition, Terminology of surface finish, Talysurf surface roughness tester; Co-coordinating measuring machine.

TRANSDUCERS AND STRAIN GAUGES: Introduction; Transducers: Characteristics, classification of transducers, Two-coil self-inductance transducer, Piezoelectric transducer; Strain Measurements:

Strain gauge, Classification, mounting of strain gauges, Strain gauge rosettes-two and three elements. Measurement of force, torque, and pressure: Introduction; Force measurement: Spring Balance, Proving ring, Load cell; Torque measurement: Prony brake, Eddy current, Hydraulic dynamometer; Pressure measurement: Mcloed gauge.

APPLIED MECHANICAL MEASUREMENTS: Speed measurement: Classification of tachometers, Revolution counters, Eddy current tachometers; Displacement measurement: Linear variable Differential transformers (LVDT). Flow measurement: Rot meters, Turbine meter; Temperature measurement: Resistance thermometers, Optical Pyrometer. Miscellaneous measurements: Humidity measurement: hair hygrometer; Density measurement: hydrometer; Liquid level measurement: sight glass, Float gauge; Biomedical measurement: Sphygmo monometer.

LIMITS, FITS & TOLERANCES: Concept of Limits, Fits, and Tolerances; Selective Assembly; Interchangeability; Hole And Shaft Basis System; Taylor's Principle; Design of Plug; Ring Gauges; IS919-1993 (Limits, Fits & Tolerances, Gauges} IS 3477 1973; concept of multi gauging and inspection. Angular Measurement: Concept; Instruments For Angular Measurements; Working and Use of Universal Bevel Protractor, Sine Bar, Spirit Level; Principle of Working of Clinometers; Angle Gauges (With Numerical on Setting of Angle Gauges). Screw thread Measurements: ISO grade and fits of thread; Errors in threads; Pitch errors; Measurement of different elements such as major diameter, minor diameter, effective diameter, pitch; Two wire method; Thread gauge micrometer; Working principle of floating carriage dial micrometer.

GEAR MEASUREMENT AND TESTING: Analytical and functional inspection; Rolling test; measurement of tooth thickness (constant chord method); Gear tooth vernier; Errors in gears such as backlash, run out, composite. Machine tool testing: Parallelism; Straightness; Squareness; Coaxiallity; roundness; run out; alignment testing of machine tools as per IS standard procedure.

E. TEXT BOOKS

T1.Mechanical measurements – Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
T2.Metrology & Measurement – Anand K Bewoor,Vinaykulakarni, Tata McGraw Hill, New Delhi, 2009.
T3.Principles of Industrial instrumentation and control systems – Channakesava. R. Alavala, DELMAR cenage learning, 2009.
T4.Principles of Engineering Metrology – RegaRajendra, Jaico publishers, 2008
T5.Dimensional Metrology – Connie Dotson, DELMAR, Cenage learning, 2007

F. REFERENCE BOOKS

R1.Instrumentation measurement and analysis – B.C. Nakara, K.K. Chaudary, second edition, Tata cgraw Hill, 2005.
R2.Engineering Metrology – R.K. Jain, Khanna Publishers, New Delhi, 2005.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in metrology.		2	2	2				1	2	2	1	
[CO2]	Distinguish between various types of errors.	1	1	3	2				2	1	1		2
[CO3]	Understand the principle of operation of an instrument and select suitable measuring device for a particular application.		3	1	3		1				1	2	2
[CO4]	Explain the concept of calibration of an instrument.	1	2	3	1							2	
[CO5]	Analyze and interpret the data obtained from the different measurements processes and present it in the graphical form, statistical form.		3	2	1			1	2	2		1	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Manufacturing Technology –II

Code:DIP16124

4 Credits | Semester IV

A. Introduction:

- To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching.
- To understand the basic concepts of Computer Numerical Control (CNC) of machine tools and CNC Programming

B. **Course Outcomes:** At the end of the course, students will be able to

[CO 1] Describe the constructional and operational features of centre lathe and other special purpose lathes.

[CO 2] Describe the constructional and operational features of shaper, planner, milling, drilling, sawing and broaching machines.

[CO 3] Explain the types of grinding and other super finishing processes apart from gear Manufacturing processes

[CO 4] Write a part program for numerical control of machine tools.

[CO 5] Explain the mechanism of material removal processes.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

C. SYLLABUS

THEORY OF METAL CUTTING E: Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools– nomenclature, Orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear,tool life, surface finish, cutting fluids and Machinability,

TURNING MACHINES: Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation, Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle : Swiss type, automatic screw type – multi spindle,

SHAPER, MILLING AND GEAR CUTTING MACHINES: Shaper , Types of operations. Drilling ,reaming, boring, Tapping, Milling operations-types of milling cutter. Gear cutting – forming and

generation principle and construction of gear milling ,hobbing and gear shaping processes –finishing of gears,

ABRASIVE PROCESS AND BROACHING: Abrasive processes: grinding wheel – specifications and selection, types of grinding process–cylindrical grinding, surface grinding, centreless grinding and internal grinding- Typical applications– concepts of surface integrity, Broaching machines: broach construction – push, pull, surface and continuous broaching machines.

CNC MACHINING: Numerical Control (NC) machine tools – CNC types, constructional details, special features, Machining centre, part programming fundamentals CNC –manual part programming – micromachining – wafer machining.

E. TEXT BOOKS

T1.Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters.
T2.Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", 3rd Edition, Tata McGraw-Hill, New Delhi.
T3.Manufacturing Technology, Metal Cutting & Machine tools– P. N. Rao, Tata McGraw-Hill Publications.

F. REFERENCE BOOKS

T4.Fundamental of metal cutting and machine tools– B. L. Juneja, New age international limited.
T5.Production Technology – R.B. Gupta, Satya Prakashan, New Delhi.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Describe the constructional and operational features of centre lathe and other special purpose lathes.		3	3	2				1		2	3	3
[CO2]	Describe the constructional and operational features of shaper, planner, milling, and drilling, sawing and broaching machines.		3	3	2				1		2	3	3
[CO3]	Explain the types of grinding and other super finishing processes apart from gear Manufacturing processes		3	3	2						1	3	3
[CO4]	Write a part program for numerical control of machine tools.		3	3	3				2		2		3
[CO5]	Explain the mechanism of material removal processes.		3	2	1						1		1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Thermal Engineering – II

Code: DIP14208

4 Credits | Semester IV

A. Introduction:

- To understand the working and applications of Gas turbines & Jet Propulsion.
- To understand the methods of computing various properties of steam.
- To understand the working of various Steam Boilers, functions of various accessories and mountings of boilers.
- To understand the Working of Steam Nozzles and Steam turbines.
- To understand the necessity of compounding and governing of a turbine.

B. Course Outcomes: At the end of the course, students will be able to

[CO 1]State the necessity of governing and compounding of a turbine.
[CO 2] Explain the working cycle of gas turbines, and the working of Jet and Rocket Engines apart from identifying the fuels used for Jet and Rocket propulsion.
[CO 3]Explain the principle of working of a steam turbine and distinguish between the impulse turbines and reaction turbines.
[CO 4] Compute the work done, enthalpy, internal energy and entropy of steam at given conditions using steam tables and Mollier chart.
[CO 5] Distinguish between water tube and fire-tube boilers and explain the function all the mountings and accessories.
[CO 6]Evaluate velocity of steam at the exit of nozzle in terms of heat drop analytically and by using Mollier chart.

C. Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

GAS TURBINES AND JET PROPULSION: Air-standard Brayton cycle; Description with p-v and T-S diagrams; Gas turbines Classification: open cycle gas turbines and closed cycle gas turbines; comparison of gas turbine with reciprocating I.C. engines and steam turbines. Applications and limitations of gas turbines; General lay-out of Open cycle constant pressure gas turbine; P-V and T-S diagrams and working; General lay-out of Closed cycle gas turbine; P-V and T-S diagrams and working. Principle of jet propulsion; Fuels used for jet propulsion; Applications of jet propulsion; Working of a turbojet engine; Principle of Ram effect; Working of a Ram jet engine; Principle of Rocket propulsion;

Working principle of a rocket engine; Applications of rocket propulsion; Comparison of jet and rocket propulsions.

PROPERTIES OF STEAM: Formation of steam under constant pressure; Industrial uses of steam; Basic definitions: saturated liquid line, saturated vapour line, liquid region, vapour region, wet region, superheat region, critical point, saturated liquid, saturated vapour, saturation temperature, sensible heat, latent heat, wet steam, dryness fraction, wetness fraction, saturated steam, superheated steam, degree of superheat, Determination of enthalpy, internal energy, internal latent heat, entropy of wet, dry and superheated steam at a given pressure using steam tables and Mollier chart for the following processes: Isochoric process, Isobaric process, Hyperbolic process, Isothermal process, Isentropic process, Throttling process, Polytropic process; Simple direct problems on the above using tables and charts; Steam calorimeters: Separating, throttling, Combined Separating and throttling calorimeters– problems.

STEAM GENERATORS: Function and use of steam boilers; Classification of steam boilers with examples; Brief explanation with line sketches of Cochran, Babcock and Wilcox Boilers; Comparison of water tube and fire tube boilers; Description with line sketches and working of modern high-pressure boilers Lamont and Benson boilers. Boiler mountings: Pressure gauge, water level indicator, fusible plug, blow down cock, stop valve, safety valve, (dead weight type, spring loaded type, high pressure and low water safety alarm); Boiler accessories: feed pump, economizer, super heater and air pre-heater; Study of steam traps & separators, Explanation of the terms: Actual evaporation, equivalent evaporation, factor of evaporation, boiler horse power and boiler efficiency; Formula for the above terms without proof; Simple direct problems on the above; Draught systems (Natural, forced & induced).

STEAM NOZZLES: Flow of steam through nozzle; Velocity of steam at the exit of nozzle in terms of heat drop using analytical method and mollier chart; Discharge of steam through nozzles; Critical pressure ratio; Methods of calculation of cross-sectional areas at throat and exit for maximum discharge; Effect of friction in nozzles and Super saturated flow in nozzles; Working steam jet injector; Simple numerical problemspower and boiler efficiency.

STEAM TURBINES: Classification of steam turbines with examples; Difference between impulse & reaction turbines; Principle of working of a simple De-lavel turbine with line diagrams- Velocity diagrams; Expression for work done, axial thrust, tangential thrust, blade and diagram efficiency, stage efficiency, nozzle efficiency; Methods of reducing rotor speed; compounding for velocity, for pressure or both pressure and velocity. Working principle with line diagram of a Parson’s Reaction turbine–velocity diagrams; Simple problems on single stage impulse turbines (without blade friction) and reaction turbine including data on blade height. Bleeding, re-heating and re-heating factors (Problems omitted); Governing of steam turbines: Throttle, By-pass & Nozzle control governing.

E. TEXT BOOKS

T1.A Course in Thermal Engineering – S. Domkundwar& C.P. Kothandaraman, Dhanpat Rai &Publication, New Delhi
T2.Thermal Engineering – R.K. Rajput, Laxmi Publication New Delhi
T3.Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002

F. REFERENCE BOOKS

R1.Treatise on Heat Engineering in MKS and SI Units – V.P. Vasandani& D.S. Kumar, MetropolitanBook Co. Pvt. Ltd, New Delhi.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	State the necessity of governing and compounding of a turbine.		**3**	**2**	**1**						**2**	**1**	**2**
[CO2]	Explain the working cycle of gas turbines, and the working of Jet and Rocket Engines apart from identifying the fuels used for Jet and Rocket propulsion.		**3**	**2**	**1**						**2**	**1**	**2**
[CO3]	Explain the principle of working of a steam turbine and distinguish between the impulse turbines and reaction turbines.		**3**	**2**	**1**						**2**	**1**	**2**
[CO4]	Compute the work done, enthalpy, internal energy and entropy of steam at given conditions using steam tables and Mollier chart.		**3**	**3**	**1**						**2**	**2**	**2**
[CO5]	Distinguish between water tube and fire-tube boilers and explain the function all the mountings and accessories.		**3**	**2**	**1**						**2**	**1**	**2**
[CO6]	Evaluate velocity of steam at the exit of nozzle in terms of heat drop analytically and by using Mollier chart.		**3**	**3**	**1**						**2**	**2**	**2**

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Tool Engineering

Code:DIP15118

3 Credits | Semester IV

A. Introduction:

- To understand metal cutting and forming process and factors affecting machinability.
- To develop knowledge of tools, dies and tool materials.
- To understand processes for increased productivity and quality.

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Select proper tool and a die for a given manufacturing operation to achieve highest productivity.
[CO 2] Classify and explain various tools and tool operations.
[CO 3] Understand concepts, principles and procedures of tool engineering.
[CO 4] Estimate tool wear and tool life

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

METAL CUTTING: Mechanics of Metal cutting; requirements of tools; cutting forces; types of chips; chip thickness ratio; shear angle ; simple numericals only; types of metal cutting process; orthogonal; oblique and form cutting; Cutting fluids: types; characteristics and applications. Tool wear: Types of wear; Tool life; Tool life equations.

MACHINABILITY: Definition; factors affecting machinability; machinability index. Tool materials: Types; characteristics; applications; Heat treatment of tool steels; Specification of carbide tips; Types of ceramic coatings. Cutting Tool Geometry: Single point cutting tool; drills; reamers; milling; cutters.

TYPES OF DIES AND CONSTRUCTION: Simple Die; Compound Die; Progressive Die; Combination Die. Punch & Die mountings: pilots; strippers; misfeed detectors; Pressure Pads; Knock outs; stock guide; Feed-Stop; guide bush; guide pins.

DIE DESIGN FUNDAMENTALS: Die Operations; blanking; piercing; shearing; cropping; notching; lancing; coining; embossing; stamping; curling; drawing; bending; forming; Die set; Die shoe; Die area. Calculation of clearances on die and punch for blanking and piercing dies; Strip layout; Calculation of material utilization factor.

FORMING DIES: Bending methods; Bending Dies; bend allowance; spring back; spanking; bending pressure; pressure pads; development of blank length. Drawing: operations; Metal flow during drawing; Calculation of Drawing blank size; variables affecting metal flow during drawing; single action and double action dies; combination dies. Fundamentals of other Tools: Constructional features of - Pressure Die casting dies; metal extrusion dies; injection molding dies; forging dies; plastic extrusion dies.

E. TEXT BOOKS

T1. Tool Design - Donaldson Anglin, Tata McGraw Hill.
T2. Production Technology- H.M.T.Jain, Tata McGraw Hill.

F. REFERENCE BOOKS

T3. A Text Book of Production engineering – P.C. Sharma, S.Chand& Co.
T4. Production Technology, R.K.Jain, Khanna Publishers.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Select proper tool and a die for a given manufacturing operation to achieve highest productivity.		3	2	3				1		3	3	2
[CO2]	Classify and explain various tools and tool operations.		3	3	3						3	3	2
[CO3]	Understand concepts, principles and procedures of tool engineering.		3	3	3						2	3	3
[CO4]	Estimate tool wear and tool life		3	3	3						2	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject:Heat Transfer

Code:DIP14191

3 Credits | Semester IV

A. INTRODUCTION:

- To understand the concepts of conduction.
- To understand the concepts of Fins heat transfer.
- To understand the concepts of radiation.
- To understand the concepts of convection.
- To understand the basics of heat exchangers.

B. COURSE OUTCOMES: At the end of the course, students will be able to

[CO 1] Recognize different modes of heat transfer.
[CO 2] Understand the concepts of Convection and radiation.
[CO 3] Apply fins and insulation under suitable conditions.
[CO 4] Analyze non-dimensional numbers for different situations.
[CO 5] Evaluate the heat exchangers on basis of NTU and LMTD method.

C. ASSESSMENT PLAN:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS:

CONDUCTION: Fourier law of heat conduction for isotropic material; Thermal conductivity; Derivation of the energy equation in three dimensions including transient effect; Nondimensional - thermal diffusivity and Fourier number, Types of boundary conditions (Dirchlet, Neumann, mixed type); One dimensional solution without heat generation; Analogy with electrical circuits.

FINS: Rectangular and pin fins. Fin effectiveness and efficiency. Critical thickness of insulation. Lumped parameter approach and physical significance of time constant, Biot number, Validity of lumped parameter approach. Introduction to Heissler Chart.

CONVECTION: Introduction, Newton's law of cooling; Momentum and energy equations in two dimensions; non dimensionalisation, importance of non dimensional quantities and their physical significance.Velocity and thermal boundary layer thickness by integral method. Analogies between momentum, heat, and mass transfer. Natural convection.

RADIATION: Physical mechanism of thermal radiation, laws of radiation, definition of black body, emissive power, intensity of radiation, emissivity, reflectivity, transitivity, irradiation, radiosity.Radiation exchange between black bodies, concept of Gray-Diffuse Isotropic (GDI) surface. Radiation exchange between GDI surfaces by radiation network and radiosity matrix method. Radiation shielding.

HEAT EXCHANGERS: Types of heat exchangers, parallel and counter flow types, Introduction to LMTD. Correction factors, fouling factor. NTU method for heat exchangers.

E. TEXT BOOKS

T1. Fundamentals of Heat and Mass Transfer by F.P.Incropera and D.P.Dewitt, 4th ed., John Wiley & Sons.
T2. Heat Transfer - A Basic Approach by M.N.Ozisik, McGrawhill.
T3. Heat Transfer by J.P.Holman, 8th ed., McGrawhill.

F. REFERENCE BOOKS

R2. Elements of Heat & Mass Transfer by Vijay Gupta, 2nd ed., New Age International Publishers.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Recognize different modes of heat transfer.		2	2	1						3		3
[CO2]	Understand the concepts of Convection and radiation.		2	2	1						3		3
[CO3]	Apply fins and insulation under suitable conditions.		3	3	2						3	2	1
[CO4]	Analyze non dimensional numbers for different situations.		2	2	1						1		2
[CO5]	Evaluate the heat exchangers on basis of NTU and LMTD method.		3	3	3				1		2	3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject:Farm Equipment &Farm Machinery

Code:DIP14190

3 Credits | Semester IV

A. INTRODUCTION:

- To find and characterize the machinery based on crop production.
- To find the field efficiency and capacities to calculate the economics of machinery.
- To find the machines usages for different tillage, and its power requirement calculations.
- To understand sowing, planting & transplanting equipment based on crop.
- To understand machinery materials and heat effects for different farm machinery equipment.

B. COURSE OUTCOMES: At the end of the course, students will be able to

[CO 1] Describe the objectives of Farm mechanization.
[CO 2] Classify the Farm Machineries, equipment and materials
[CO 3] Explain selection of the machineries.
[CO 4] Discuss the forces acting on tillage tools and hitching systems.
[CO 5] Understand the calibration, constructional features and working of various farm equipment.

C. ASSESSMENT PLAN:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS:

FARM MECHANIZATION: Introduction to farm mechanization. Classification of farm machines. Unit operations in crop production. Identification and selection of machines for various operations on the farm. Hitching systems and controls of farm machinery.

FIELD CAPACITIES AND FIELD EFFICIENCY: Calculation of field capacities and field efficiency. Calculations for economics of machinery usage, comparison of ownership with hiring of machines. Introduction to seed-bed preparation and its classification. Familiarization with land reclamation and earth moving equipment.

MACHINES USED FOR TILLAGE: Introduction to machines used for primary tillage, secondary tillage, rotary tillage, deep tillage and minimum tillage. Measurement of draft of tillage tools and calculations for power requirement for the tillage machines. Introduction to tillage machines like mould-

board plough, disc plough, chisel plough, sub-soiler, harrows, puddler, cultivators, identification of major functional components. Attachments with tillage machinery.

SOWING, PLANTING & TRANSPLANTING EQUIPMENT: Introduction to sowing, planting & transplanting equipment. Introduction to seed drills, no-till drills, and strip-till drills. Introduction to planters, bed planters and other planting equipment like sugarcane, potato. Study of types of furrow openers and metering systems in drills and planters. Calibration of seed-drills/ planters. Adjustments during operation.

MATERIALS FOR FARM MACHINE: Introduction to materials used in construction of farm machines. Heat treatment processes and their requirement in farm machines. Properties of materials used for critical and functional components of agricultural machines. Introduction to steels and alloys for agricultural application. Identification of heat treatment processes specially for the agricultural machinery components.

E. TEXT BOOKS

T1. Principles of Farm Machinery - R.A. Kepner, Roy Bainer, and E. L. Berger
T2. Farm Machinery and Equipment - H. P. Smith
T3. Farm Machinery and equipment - C. P. Nakra
T4. Engineering principles of Agril. Machines - Dr. Ajit K. Srivastav, Caroll E. Goering and Roger P. Rohrbach.
T5. Farm Machinery – an Approach - S. C Jain & Grace Phillips

F. REFERENCE BOOKS

R1. Agril. Engineering through worked out examples - Dr. R. Lal and Dr. A.C. Dutta
R2. Farm Power and Machinery Engineering - Dr.R. Suresh and Sanjay Kumar

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Describe the objectives of Farm mechanization.		2		1	2	2				3	1	
[CO2]	Classify the Farm Machineries, equipment and materials		1	1	1	2	2		1		3	1	
[CO3]	Explain selection of the machineries.		2	1	3						3	1	
[CO4]	Discuss the forces acting on tillage tools and hitching systems.		3	2	2						2	3	3
[CO5]	Understand the calibration, constructional features and working of various farm equipment.		2	3	3						2	3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject:Computer Integrated Manufacturing

Code:DIP14185

3 Credits | Semester IV

A. INTRODUCTION:

- To understand different types of manufacturing available today such as the Special manufacturing System, the Manufacturing Cell, and the Flexible Manufacturing System (FMS).
- To learn the fundamentals of computer assisted numerical control programming and programming languages.
- To learn the concepts of Computer Integrated Manufacturing and Management System and automated flow lines.
- To learn the guidelines and criteria for implementing CAD/CAM Systems and associated software for design, Manufacturing, and a common CAD/CAM data base organized to serve both design and manufacturing.

B. COURSE OUTCOMES: At the end of the course, students will be able to

[CO 1] Understand basic components and networks involved in CIM.
[CO 2] Understand hardware, software and product modeling at industry level.
[CO 3] Understand process planning and program coding of task.
[CO 4] Devise a manufacturing cell and cellular manufacturing system.
[CO 5] Design automated material handling and storage systems for a typical production system.

C. ASSESSMENT PLAN:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS:

CONCEPT OF COMPUTER INTEGRATED MANUFACTURING (CIM): Basic components of CIM; Distributed database system; distributed communication system. computer networks for manufacturing; future automated factory; social and economic factors

COMPUTER AIDED DESIGN (CAD): CAD hardware and software; product modelling, automatic drafting; engineering analysis; FEM design review and evaluation; Group Technology Centre.

COMPUTER AIDED MANUFACTURING (CAM): Computer assisted NC part programming; Computer assisted robot programming, Computer aided process planning (CAPP); Computer aided material requirements planning (MRP)

COMPUTER AIDED PRODUCTION SCHEDULING: Computer aided inspection planning; Computer aided inventory planning. Flexible manufacturing system (FMS); concept of flexible manufacturing.

INTEGRATING NC MACHINES, ROBOTS, AGVS, AND OTHER NC EQUIPMENT: Computer aided quality control; Business functions, Computer aided forecasting; Office automation

E. TEXT BOOKS

T1.CAD, CAM, CIM by P. Radhakrishnan and S. Subramanyan, New Age International Publishers.
T2.Computer Integrated Manufacturing by Paul G. Rankey, Prentice Hall.

F. REFERENCE BOOKS

R2.Robotics Technology and Flexible Automation – S.R. Deb, TMH

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Understand basic components and networks involved in CIM.	**2**	**2**	**1**	**1**							**1**	
[CO2]	Understand hardware, software and product modeling at industry level.	**1**	**3**	**1**	**3**							**1**	
[CO3]	Understand process planning and program coding of task.	**1**	**3**	**3**	**2**					**1**			**3**
[CO4]	Devise a manufacturing cell and cellular manufacturing system.	**1**	**3**	**3**	**2**						**2**		**3**
[CO5]	Design automated material handling and storage systems for a typical production system.	**1**	**3**	**3**	**2**						**2**		**3**

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject:Refrigeration &Air-conditioning

Code: DIP16142

3 Credits | Semester IV

A. INTRODUCTION:

- To understand the basics of Refrigeration cycles.
- To understand basics of vapor compression and vaporabsorption systems.
- To identify components and refrigerants and lubricants of a refrigeration system.
- To understand control strategies for refrigeration system.
- To understand the basics about air conditioning systems.

B. COURSE OUTCOMES: At the end of the course, students will be able to

[CO 1] Define refrigeration and types of Refrigeration cycles
[CO 2] Identify the controlling components for a refrigeration system.
[CO 3] Identify the components required for refrigeration system
[CO 4] Explain Vapour Compression and VapourAbsorbtion System working principles.
[CO 5] Explain the working principles of Air-conditioning.

C. ASSESSMENT PLAN:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS:

INTRODUCTION TO REFRIGERATION: Definition of Refrigeration; Refrigerating effect-unit of refrigeration-Coefficient of performance, Types of Refrigeration-Ice, dry ice, Steam jet, Throttling, Liquid nitrogen refrigeration, Carnot refrigeration Cycle; Air refrigeration- Bell - Coleman cycle, PV& TS diagram; Advantage and disadvantages in air refrigeration; Simple problems.

REFRIGERATION SYSTEMS: Basic Components, Flow diagram of working of Vapour compression cycle; Representation of the vapour compression cycle on P-H, T-S & P-V Diagram; Expression for Refrigerating effect, work done and power required. Types of Vapour Compression cycle; Effects of super heating and under cooling, its advantages and disadvantages, Simple Vapour absorptions cycle and its flow diagram; Simple Electrolux system for domestic units; Comparison of Vapour absorption and vapour compression system; Simple problems on vapour compression cycle.

REFRIGERATION EQUIPMENTS: Compressor - types of compressors; Hermetically sealed and Semi hermetically sealed compressor. Condensers - Air Cooled, water cooled, natural and forced draught cooling system; Advantages and disadvantages of air cooled and water cooled condensers. Evaporators - natural, convection, forced convection types. Refrigerants and lubricants: Introduction to refrigerants; Properties of good refrigerants; Classification of refrigerants by group number and commonly used refrigerants in practice; Detection of refrigerants leakage; Charging the system with refrigerant; Lubricants used in refrigeration and their properties.

REFRIGERANT FLOW CONTROLS: Capillary tube; Automatic Expansion valve; Thermo static expansion valve; High side and low side float valve; Solenoid valve; Evaporator pressure regulator. Application of refrigeration: Slow and quick freezing; Cold storage and Frozen storage; Dairy refrigeration; Ice making industry; Water coolers.

AIR CONDITIONING: Introduction to Air conditioning; Factors affecting Air conditioning; Psychometric chart and its use; Psychometric process-sensible heating and cooling, Humidifying and dehumidifying; Adiabatic saturation process; Equipments used in air conditioning cycle; Air conditioning units and plants. Refrigeration and Air-conditioning tools: Tools used in refrigeration and Air conditioner installation; Installation procedure; Faults in refrigeration and air conditioning system; Servicing procedure.

E. TEXT BOOKS

T1.Refrigeration and Air Conditioning – Sadhu Singh, Khanna Book Publishing Co., New Delhi.
T2. Refrigeration and Air Conditioning – S. Domakundawar, Dhanpat Rai publications.
T3. Refrigeration and Air Conditioning – A.S.Sarao& G.S. Gabi, 6th edition, Satya Prakashan publications, New Delhi, 2004.
T4. Principles of Refrigeration – Roy J.Dossat, 5th edition, Pearson Publications, 2001.

F. REFERENCE BOOKS

R1.Refrigeration and Air Conditioning – M.ZakriaBaig, Premier/ Radiant Publishing House.
R2.Refrigeration and Air Conditioning – C.P Arora, Tata McGraw Hill Education, 2000.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Define refrigeration and types of Refrigeration cycles		3	1	2						2		1
[CO2]	Identify the controlling components for a refrigeration system.		3	2	2						2	2	1
[CO3]	Identify the components required for refrigeration system		2	2	3						1	2	1
[CO4]	Explain Vapour Compression and VapourAbsorbtion System working principles.		3	1	2						1	1	2
[CO5]	Explain the working principles of Air-conditioning.		3	1	2						1	1	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject:Material-Handling Systems

Code:DIP16141

3 Credits | Semester IV

A. INTRODUCTION:

- To know the operational features of the material handling equipment & its practical applications.
- To understand, select, operate and maintain the material handling equipment.
- To understand different material handling processes used in industries.
- To understand & appreciate safety instrumentation for equipment.

B. COURSE OUTCOMES: At the end of the course, students will be able to

[CO1] Identify, compare & select proper material handling equipment for specified applications.
[CO2] Know the controls & safety measures incorporated on material handling equipment.
[CO3] Understand constructional & operational features of various materials handling systems.
[CO4] Understand & appreciate safety instrumentation for equipment
[CO5] Appreciate the role of material handling devices in mechanization & automation of industrial process.

C. ASSESSMENT PLAN:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS:

INTRODUCTION TO MATERIAL HANDLING SYSTEM: Main types of Material handling equipment& their applications; Types of load to be handled; Types of Movements, Methods of stacking, loading & unloading systems; Principles of Material Handling Systems; Modern trends in Materials handling.

HOISTING MACHINERY & EQUIPMENTS: Construction, Working & Maintenance of different types of hoists such as Lever operated hoist, Portable hand chain hoist, Differential hoists, Worm geared and Spur geared hoists, Electric & Pneumatic hoists, Jumper, Construction, Working & Maintenance of different types of cranes such as Rotary cranes, Trackless cranes, Mobile cranes, Bridge cranes, Cable cranes, Floating cranes & Cranes traveling on guide rails, Construction, Working & Maintenance of

Elevating equipments such as Stackers, Industrial lifts, Freight elevators, Passenger lifts, and Mast type's elevators, Vertical skip hoist elevators.

CONVEYING MACHINERY: Construction, Working & Maintenance of Traction type conveyors such as Belt conveyors, Chain conveyors, Bucket elevators, Escalators, Construction, and Working& Maintenance of Traction less type conveyors such as Gravity type conveyors, Vibrating & Oscillating conveyors, Screw conveyors, Pneumatic & Hydraulic conveyors, Hoppers gates & Feeders. Surface transportation equipment: Construction, Function, Working of Trackless equipment such as Hand operated trucks, Powered trucks, Tractors, Automatic Guided vehicle, Industrial Trailers, Construction, Function, Working of Cross handling equipment such as Winches, Capstans, Turntables,Transfer tables, Monorail conveyors.

COMPONENTS OF MATERIAL HANDLING SYSTEMS: Flexible hoisting appliances such as Welded load chains, Roller chains, Hemp ropes, Steel wire ropes, Fastening methods of wire & chains, Eye bolts, Lifting tackles, Lifting & Rigging practices, Load handling attachments: a) Various types of hooks-Forged, Triangular eye hooks, Appliances for suspending hooks b) Crane grab for unit & piece loads c) Electric lifting magnet, vacuum lifter. d) Grabbing attachment for loose materials e) Crane attachment for handling liquids/molten metals, Construction & Working of arresting gear & Brakes; Construction & use of electromagnetic shoe brakes, Thruster operated shoe brakes, Control brakes.

MECHANISM USED IN MATERIAL HANDLING EQUIPMENT: Steady state motion; Starting & stopping of motion in following mechanisms: Hoisting mechanism, Lifting Mechanism, Traveling Mechanism, Slewing Mechanism, Rope & chain operated Cross- Traverse Mechanism, Selection of Material Handling Equipment: Factors affecting choice of material handling equipment such as Type of loads, Hourly capacity of the unit, Direction & length of travel, Methods of stocking at initial, final & intermediate points, Nature of production process involved, Specific load conditions & Economics of material handling system.

E. TEXT BOOKS

T1. Material handling (Principles & Practice) – Allegri T. H., CBS Publisher, New Delhi.
T2. Plant Layout & Materials Handling – Apple J. M., JohnWiley Publishers.
T3. Material Handling Equipment – N. Rundenko, Peace Publisher, Moscow.

F. REFERENCE BOOKS

R1. Material Handling Equipment – M. P. Alexandrov, MIR Publisher, Moscow.
R2. Material Handling Equipment – Y. I. Oberman, MIR Publisher, Moscow.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Identify, compare & select proper material handling equipment for specified applications.	1	3	1	3				1		2	3	2
[CO2]	Know the controls & safety measures incorporated on material handling equipment.		3	3	3				1		3	3	3
[CO3]	Understand constructional & operational features of various materials handling systems.	1	3	2	3				1		2	3	2
[CO4]	Understand & appreciate safety instrumentation for equipment	2	2	3	3						3	3	3
[CO5]	Appreciate the role of material handling devices in mechanization & automation of industrial process.		2	2	2				1		1	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Essence of Indian Knowledge Tradition

Code:DIP13172

0 Credits | Semester IV

A. Introduction:

- The course aims at imparting basic principles of thought process, reasoning and differencing. Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-I focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Basic principles of thought process, reasoning and differencing.

[CO2] Introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care systems.

[CO3] Focuses on Indian philosophical traditions, Indian linguistic tradition and Indian artistic tradition.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	10
	Attendance	2.5
	Assignment	2.5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

BASIC STRUCTURE OF INDIAN KNOWLEDGE SYSTEM: Basic structure of Indian Knowledge System. अष्टादशविद्या -४वेद,४उपवेद (आयुर्वेद, धनुर्वेद, गन्धर्ववेद, स्थापत्य आदि)

BASIC STRUCTURE OF INDIAN KNOWLEDGE SYSTEM: ६वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद) ४ उपाङ्ग (धर्मशास्त्र, मीमांसा, पुराण, तर्कशास्त्र)

MODERN SCIENCE AND INDIAN KNOWLEDGE SYSTEM: Modern Science and Indian Knowledge System.

YOGA AND HOLISTIC HEALTH CARE LAWS: Yoga and Holistic Health care.

CASE STUDIES: Case studies.

E. TEXT BOOKS

T1. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bharatiya.
T2.Vidya Bhavan, Mumbai. 5th Edition, 2014 SwamiJitatmanand, Modern Physics and Vedant, BharatiyaVidyaBhavan
T3Swami Jitatmanand, Holistic Science and Vedant, BharatiyaVidyaBhavan.
T4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
T5Fritzof Capra, The Wave of life .

F. REFERENCE BOOKS

R1. VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay
R2. Foundation, Velliarnad, Arnakulam Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata
R3. GN Jha (Eng. Trans.), Ed. RN Jha, Yoga-darshanam with Vyasa Bhashya
R4. VidyanidhiPrakashan, Delhi 2016 RNJha, Science of Consciousness Psychotherapyand Yoga Practices, Vidyanidhi
R5.Prakashan, Delhi 2016 P B Sharma (English translation), ShodashangHridayan

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES					CORRELATION WITH PROGRAM SPECIFIC OUTCOMES						
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Basic principles of thought process, reasoning and differencing.						2	1					
[CO2]	Introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care systems.						1				1		
[CO3]	Focuses on Indian philosophical traditions, Indian linguistic tradition and Indian artistic tradition.										1		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Measurements &Metrology lab

Code: DIP14201

1 Credits | Semester IV

A. Introduction:

- To understand techniques for precise measurement of the dimensions of various objects and shapes.

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Measure various component of linear measurement using Vernier calipers and Micrometer.
[CO 2] Measure various component of angle measurement using sine bar and bevel Protractor.
[CO 3] Measure the geometrical dimensions of V-thread and spur gear

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

S.No.	Name of Experiment
1	Measure the diameter of a wire using micrometre and compare the result with digital micrometer
2	Measure the angle of the machined surface using sine bar with slip gauges.
3	Measure the angle of a V-block / Taper Shank of Drill / Dovetail using universal bevel Protractor.
4	Measure the dimensions of ground MS flat/cylindrical bush using Vernier Caliper compare with Digital/Dial Vernier Caliper.
5	Measure the geometrical dimensions of V-Thread using thread Vernier gauge.

6	Measure the thickness of ground MS plates using slip gauges.

D. TEXT BOOKS

T1. Engineering Metrology – R. K. Jain
T2. Engineering precision metrology – R. C. Gupta

E. Reference Books:

T3. A Hand book of Industrial Metrology – ASME

F. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Measure various component of linear measurement using Vernier calipers and Micrometer.	2	2	3	2						2	2	1
[CO2]	Measure various component of angle measurement using sine bar and bevel Protractor.	1	2	3	3						1	2	1
[CO3]	Measure the geometrical dimensions of V-thread and spur gear	1	3	3	3						1	3	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Computer Aided Machine-Drawing Practice Lab

Code:DIP14184

1 Credits | Semester IV

A. Introduction:

- To understand the fundamentals and use CAD.
- To conceptualize drafting and modeling in CAD.
- To interpret the various features in the menu of solid modeling package.
- To synthesize various parts or components in an assembly.
- To prepare CNC programmes for various jobs.

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Demonstrate the working of CNC turning and milling machine
[CO 2] Explain the 3D commands and features of a CAD software
[CO 3] Assess the part program, edit and execute in CNC turning and machining centre
[CO 4] Create 3D solid model and find the mass properties of simple solids
[CO 5] Develop the part program using simulation software for Lathe and Milling

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

S.No.	Name of Experiment
1	Introduction: Part modelling; Datum Plane; constraint; sketch; dimensioning; extrude; revolve; sweep; blend; protrusion; extrusion; rib; shell; hole; round; chamfer; copy; mirror; assembly; align; orient.
2	Exercises: 3D Drawings of 1). Geneva Wheel; 2). Bearing Block; 3). Bushed bearing: 4). Gib and Cotter joint; 5).Screw Jack; 6). Connecting Rod

3	Using Linear and Circular interpolation - Create a part program and produce component in the Machine.
4	Using Stock removal cycle – Create a part program for multiple turning operations and produce component in the Machine.
5	Using canned cycle - Create a part program for thread cutting, grooving and produce component in the Machine.
6	Using Linear interpolation and Circular interpolation – Create a part program for grooving and produce component in the Machine.
7	Using canned cycle - Create a part program for drilling, tapping, counter sinking and produce component in the Machine.
8	Using subprogram - Create a part program for mirroring and produce component in the Machine.

E. TEXT BOOKS

T1.Machine Drawing – P.S. Gill S. K. Kataria& Sons, Delhi., 17th Revised edition, 2001
T2.Mechanical Draughtsmanship - G.L. TamtaDhanpat Rai & Sons, Delhi, 1992
T3.Inside AutoCAD – D. Raker and H. Rice, BPB Publications, New Delhi, 1985

F. Reference Books:

R1.CAD/CAM/CIM – P. Radhakrishnan, S. Subramaniyan& V. Raju, New Age International Pvt. Ltd., New Delhi, 3rd Edition,
R2.Engineering AutoCAD, A.P. Gautam& Pradeep Jain, Khanna Book Publishing Co., Delhi.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Demonstrate the working of CNC turning and milling machine		2	3	2						2	2	3
[CO2]	Explain the 3D commands and features of a CAD software		2	3	2						2		3
[CO3]	Assess the part program, edit and execute in CNC turning and machining centre		2	3	3				1	2	2	1	3
[CO4]	Create 3D solid model and find the mass properties of simple solids		3	3	3					1	2		3
[CO5]	Develop the part program using simulation software for Lathe and Milling		3	3	3				1	1	2		3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Manufacturing Technology –II Lab

Code: DIP16127

1 Credits | Semester IV

A. Introduction:

- To provide programming practice on CNC machine tools
- To impart knowledge on the fundamental concepts and principles of metrology
- To explain the need of various modern measuring instruments and precision measurements

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Perform operations on drilling, shaping, milling and grinding machines.
[CO 2] Apply various measuring instruments for taking dimensions
[CO 3] Produce articles of industrial application such as Spur gear, square headed bolt, V- block
[CO 4] Dismantle and assemble the components on drilling, shaping, milling and grinding machines.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

S.No.	Name of Experiment
1	Exercise on grinding machine
2	Study and preparation of program, simulation and exercise on CNC lathe:-turning, step turning, taper turning, thread cutting, ball and cup turning etc.
3	Study and preparation of program, simulation and exercise on CNC milling machine: - surface milling, pocket milling, contour milling etc.
4	Drilling Exercise (Three different sized holes for different materials maintaining uniform distance between them)
5	Shaping a Hexagon on a round bar, key ways, grooves splines

6	Shaping step block cut dovetail to angles 60, 90, 120 degrees
7	Simple planning exercise cutting 'T' slots (one model)
8	Milling-square-hexagon from round bars with indexing and without indexing
9	Grinding flat surface on a surface grinder using magnetic chuck and clamping devices
10	Dismantling some of the components of drilling machine and service, assemble the same
11	Dismantling some of the components of shaper head and then assemble the same
12	Dismantling some of the components of Milling machines and service, assemble the same

E. TEXT BOOKS

T1.Elements of Workshop Technology (Volume I & II) – HajraChowdry&Bhattacharaya, Media Promoters, 11th Edition, 2007.

T2. Introduction of Basic Manufacturing Processes and Workshop Technology – Rajendersingh, New age International (P) Ltd. NewDelhi, 2006.

F. Reference Books:

R1. Production Technology – HMT, 18th edition, Tata McGraw Hill, New Delhi.

R2.Manufacturing process – Myro N Begman, 5 th edition, Tata McGraw Hill, New Delhi.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Perform operations on drilling, shaping, milling and grinding machines.		3	3	3						3	2	3
[CO2]	Apply various measuring instruments for taking dimensions	2	2	3	3				2		3	3	2
[CO3]	Produce articles of industrial application such as Spur gear, square headed bolt, V- block		3	2	3				1		2	2	3
[CO4]	Dismantle and assemble the components on drilling, shaping, milling and grinding machines.		3	2	3				2		3	3	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Thermal Engineering II Lab

Code: DIP14209

1 Credits | Semester IV

A. Introduction:

- To understand the working of boilers, compressors and IC engines.
- To observe various parts of engines and understand their functions.
- To perform various tests on IC engines and calculate performance parameters.
- To understand economical and optimum running conditions of the engines

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Evaluate the performance characteristics of single cylinder diesel/petrol engine at different loads and draw the heat balance sheet.
[CO 2] Find the indicated power of individual cylinders of an engine by using morse test.
[CO 3] Evaluate the performance characteristics Multi stage air compressor
[CO 4]Evaluate the co efficient of performance of refrigerator

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	5
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

S.No.	Name of Experiment
1	Study of Chochran boiler with model
2	Study of Babcock and Wilcox boiler with model
3	Study of simple vertical boiler with model
4	Study of boiler mountings and accessories
5	Conduct performance test on VCR test rig to determine COP of the refrigerator
6	Conduct Morse test to determine the indicated power of individual cylinders

7	Conduct Performance test on 2-S CI/SI engine
8	Conduct Performance test on 4-S CI/SI engine.
9	Conduct performance test on A/C test rig to determine COP of the refrigerator

E. TEXT BOOKS

T1.Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002
T2.A Course in Thermal Engineering – S. Domkundwar& C.P. Kothandaraman, Dhanpat Rai & Publication New Delhi.

F. Reference Books:

T3.Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, NewDelhi

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Evaluate the performance characteristics of single cylinder diesel/petrol engine at different loads and draw the heat balance sheet.		3	3	3		2				2	3	2
[CO2]	Find the indicated power of individual cylinders of an engine by using morse test.		3	3	2						2	3	
[CO3]	Evaluate the performance characteristics Multi stage air compressor		3	3	2						2	2	2
[CO4]	Evaluate the co efficient of performance of refrigerator		3	3	3		2				2	3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Minor Project

Code: DIP14203

2 Credits | Semester IV

A. Introduction: The objective of this course is to prepare students to use applications of the theory and practical learned during the course. It will also help students to develop an industry or research oriented project. This course helps students how to carry out project/studies in the field of interest of the student or as given by the industry.

B. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	15
	Attendance	
	Assignment	
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

ARKA JAIN University
Jharkhand

Syllabus of

Diploma in mechanical Engineering

Semester-V

ARKAJAIN University, Jharkhand
School of Engineering & IT
Department of Engineering
Faculty – Diploma in Mechanical Engineering (DEME)
Scheme of Study (w.e.f Batch 2020-23)

SEMESTER –I (Group-A)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Communication Skills in English	HSC	3	3	100	70	20	5	5
2	Mathematics-I	BSC	4	4	100	70	20	5	5
3	Applied Physics	BSC	4	4	100	70	20	5	5
4	Applied Chemistry	BSC	4	4	100	70	20	5	5
	Practical								
5.	Engineering Workshop Practice	ESC	2	4	50	35	5	5	5
6.	Applied Physics Lab	BSC	1	2	50	35	5	5	5
7.	Applied Chemistry Lab	BSC	1	2	50	35	5	5	5
8.	Communication Skills in English Lab	HSC	1	2	50	35	5	5	5
	Total		**20**	**25**	**600**	**420**	**100**	**40**	**40**

SEMESTER I (Group-B)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Mathematics -I	BSC	4	4	100	70	20	5	5
2	Fundamentals of Electrical & Electronics Engg.	ESC	4	4	100	70	20	5	5
3	Introduction to IT system	ESC	3	3	100	70	20	5	5
4	Engineering Mechanics	ESC	4	4	100	70	20	5	5
5	Environmental Science	AC	0	2	50	35	10	2.5	2.5
	Practical								
6	Fundamentals of electrical & electronics Engg. Lab	ESC	1	2	50	35	5	5	5
7	Introduction to IT system Lab	ESC	1	2	50	35	5	5	5
8	Engineering Mechanics Lab	ESC	1	2	50	35	5	5	5
9	Engineering Graphics	ESC	2	4	50	35	5	5	5
	Total		**20**	**27**	**650**	**455**	**110**	**42.5**	**42.5**

SEMESTER II (Group-A)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Mathematics -II	BSC	4	4	100	70	20	5	5
2	Fundamentals of Electrical & Electronics Engg.	ESC	4	4	100	70	20	5	5
3	Introduction to IT system	ESC	3	3	100	70	20	5	5
4	Engineering Mechanics	ESC	4	4	100	70	20	5	5
5	Environmental Science	AC	0	2	50	35	10	2.5	2.5
	Practical								
6	Fundamentals of electrical & electronics Engg. Lab	ESC	1	2	50	35	5	5	5
7	Introduction to IT system Lab	ESC	1	2	50	35	5	5	5
8	Engineering Mechanics Lab	ESC	1	2	50	35	5	5	5
9	Engineering Graphics	ESC	2	4	50	35	5	5	5
	Total		**20**	**27**	**650**	**455**	**110**	**42.5**	**42.5**

SEMESTER –II(Group-B)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Communication Skills in English	HSC	3	3	100	70	20	5	5
2	Mathematics-II	BSC	4	4	100	70	20	5	5
3	Applied Physics	BSC	4	4	100	70	20	5	5
4	Applied Chemistry	BSC	4	4	100	70	20	5	5
	Practical								
5.	Engineering Workshop Practice	ESC	2	4	50	35	5	5	5
6.	Applied Physics Lab	BSC	1	2	50	35	5	5	5
7.	Applied Chemistry Lab	BSC	1	2	50	35	5	5	5
8.	Communication Skills in English Lab	HSC	1	2	50	35	5	5	5
	Total		**20**	**25**	**600**	**420**	**100**	**40**	**40**

SEMESTER-III

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Strength of Materials	PCC	4	4	100	70	20	5	5
2	Material Science & Engineering	PCC	3	3	100	70	20	5	5
3	Fluid Mechanics & Hydraulic Machinery	PCC	4	4	100	70	20	5	5
4	Manufacturing Technology-I	PCC	3	3	100	70	20	5	5
5	Thermal Engineering-I	PCC	3	3	100	70	20	5	5
	Practical								
6	Strength of Materials Lab	PCC	1	2	50	35	5	5	5
7	Fluid Mechanics & Hydraulic Machinery Lab	PCC	1	2	50	35	5	5	5
8	Manufacturing Technology-I Lab	PCC	1	2	50	35	5	5	5
9	Thermal Engineering- I Lab	PCC	1	2	50	35	5	5	5
10	Summer Internship-I(3-4 Weeks)	PROJ	2	0	50	35	15	0	0
	TOTAL		**23**	**25**	**750**	**525**	**135**	**45**	**45**

SEMESTER-IV

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Measurements & Metrology	PCC	3	3	100	70	20	5	5
2	Manufacturing Technology-II	PCC	4	4	100	70	20	5	5
3	Thermal Engineering - II	PCC	4	4	100	70	20	5	5
4	Elective-I Tool Engineering Heat Transfer Farm Equipment & Farm Machinery	PEC	3	3	100	70	20	5	5
5	Elective-II Computer Integrated Manufacturing Refrigeration & Air-conditioning Material Handling Systems	PEC	3	3	100	70	20	5	5
6	Essence of Indian Knowledge Tradition	AC	0	2	50	35	10	2.5	2.5
	Practical								
7	Measurements & Metrology Lab	PCC	1	2	50	35	5	5	5
8	Computer Aided Machine Drawing Practice Lab	PCC	1	2	50	35	5	5	5
9	Manufacturing Technology –II Lab	PCC	1	2	50	35	5	5	5
10	Thermal Engineering– II Lab	PCC	1	2	50	35	5	5	5
11	Minor Project	PROJ	2	4	50	35	15	0	0
	TOTAL		**23**	**31**	**800**	**560**	**145**	**47.5**	**47.5**

SEMESTER V

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory / Practical Exam	Mid Term Theory / Practical Exam	CIA*	Attendance
1	Advanced Manufacturing Processes	PCC	3	3	100	70	20	5	5
2	Theory of Machines & Mechanisms	PCC	3	3	100	70	20	5	5
3	Industrial Engineering & Management	PCC	3	3	100	70	20	5	5
4	Elective-III Computer Aided Design and Manufacturing Automobile Engineering Hybrid Vehicles	PEC	3	3	100	70	20	5	5
5	Elective-IV Industrial Robotics & Automation Power Plant Engineering Mechatronics	PEC	3	3	100	70	20	5	5
6	Open Elective-I Renewable Energy Technology Operation Research Internet of Thing	OEC	3	3	100	70	20	5	5
	PRACTICAL								
7	CAD/CAM Lab	PCC	1	2	100	70	20	5	5
8	Theory of Machines & Mechanisms Lab	PCC	1	2	50	35	5	5	5
9	Summer Internship-II(4-6 Weeks)	PROJ	3	0	100	70	30		
10	Major Project-I (Project to be carried over to next semester)	PROJ	1	2	50	35	15		
	TOTAL		**24**	**24**	**900**	**630**	**190**	**40**	**40**

SEMESTER VI

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory / Practical Exam	CIA*	Attendance
1	Design of Machine Elements	PCC	3	3	100	70	20	5	5
2	Production & Operations Management	PCC	3	3	100	70	20	5	5
3	Entrepreneurship and Start-ups	PROJ	4	4	100	70	20	5	5
4	Open Elective-II Sustainable Development Robotics Artificial Intelligent & Machine Learning	OEC	3	3	100	70	20	5	5
5	Open Elective-III Project Management Product Design Cyber Security Laws, Standards & IPR 3-D Printing	OEC	3	3	100	70	20	5	5
6	Indian Constitution	AC	0	2	50	35	10	2.5	2.5
	PRACTICAL								
7	Seminar	PROJ	1	2	50	35	15	0	0
8	Major Project-II	PROJ	3	0	100	70	30	0	0
	TOTAL		**20**	**20**	**700**	**490**	**155**	**27.5**	**27.5**

Distribution of Credit across 6 semesters:

Sl. No	Type of Paper	No. of Paper	Total Credit
1	Humanities and Social Sciences Courses **(HSC)**	3	7
2	Basic Science courses**(BSC)**	6	18
3	Engineering Science courses **(ESC)**	8	18
4	Professional core courses (**PCC)**	23	53
5	Professional Elective courses**(PEC)**	4	12
6	Open Electives Courses (**OEC)**	3	9
7	Project work, seminar and internship in industry or elsewhere**(PROJ)**	6	12
8	Audit Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]**(AC)**	3	(non-credit)
	Total	56	129

CIA – Continuous Internal Assessment – Based on Projects / Assignment during the semester

Note:

AICTE Activity Points to be earned by students admitted to Diploma program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 3 year Diploma program, is required to earn 75 activity points in addition to the total credits earned for the program. Students entering 3 years Diploma Program through lateral entry are required to earn 50 activity points in addition to the total credits earned for the program.
The activity points earned by the student shall be reflected on the students 6th Semester grade card.
The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled.
Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.
Incase student fail to earn the prescribed activity points, Sixth semester Grade Card shall be issued only after earning the required activity Points.
Students shall be eligible for the award of degree only after the release of the Six Semester grade card.

There are two groups (A & B) in semester 1 & 2. The Group division will be decided by The Dean SoE& IT before commencement of classes*

ARKAJAIN University, Jharkhand
School of Engineering & IT
Department of Engineering
Faculty – Diploma in Mechanical Engineering (DEME)
PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PROGRAM OUTCOMES

After completing this undergraduate program, a learner:

[PO.1]. Basic knowledge: An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems

[PO.2]. Discipline knowledge: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.

[PO.3]. Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

[PO.4]. Engineering Tools: Apply appropriate technologies and tools with an understanding of the limitation.

[PO.5]. The engineer and society: Demonstrate knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering practice.

[PO.6]. Environment and sustainability: Understand the impact of the engineering solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development..

[PO.7]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

[PO.8]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse/multidisciplinary teams.

[PO.9]. Communication: An ability to communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.10]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological changes.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Maintenance selection and use of various equipment and machinery and instruments in mechanical processes.

[PSO.2]. Supervise and manage production process and demonstrate a knowledge of management and business practices, such as risk and change management, and understand their limitations.

Subject: Advanced Manufacturing Processes

Code:DIP15115

3 Credits | Semester V

A. Introduction:

- To Know the functions of Jigs and Fixtures.
- To know the applications of jig-boring machines.
- To identify different fabrication methods of plastic processing viz., sheet forming, blow moulding,
- laminating and reinforcing of plastics.
- To distinguish between non-conventional machining and traditional machining processes.
- To know about the advancements in the area of manufacturing and production processes.
- To impart knowledge & skills necessary for working in modern manufacturing environment.
- To get familiarized with working principles and operations performed on non-traditional machines,
- machining centre, SPM, automated machines and maintenance of machine tools.

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Know the Operation and control of different advanced machine tools and equipment's.
[CO2] Produce jobs as per specified requirements by selecting the specific machining process.
[CO3] Develop the mind set for modern trends in manufacturing and automation.
[CO4] Identify the different fabrication methods viz., sheet forming, blow moulding, laminating and reinforcing of plastics.
[CO5] Know different non-traditional machining processes, CNC milling machines, special purpose machines.
[CO6] Work as maintenance engineer.

C. Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

JIGS & FIXTURES: Definition of jig; Types of jigs: Leaf jig, Box and Handle jig, Template jig, Plate jig, Indexing jig, Universal jig, Vice jigs - Constructional details of the above jigs; General consideration in the design of drill jigs; Drill bush. Types of fixtures: Vice fixtures, Milling fixtures, Boring fixtures, Grinding fixtures - constructional details of the above fixtures; Basic principles of location; Locating

methods and devices; Basic principles of the clamping; Types of clamps: Strap clamps, Cam clamps, Screw clamps, Toggle clamps, Hydraulic and Pneumatic clamps.

JIG BORING& PLASTIC PROCESSING: Introduction; Jig boring on vertical milling machine. Types jig boring machines: Open front machine, Cross rail type machine. Constructional details & their working. System of location of holes. Processing of plastics. Moulding processes: Injection moulding, Compression moulding, Transfer moulding; Extruding. Casting; Calendering; Fabrication methods-Sheet forming, Blow moulding. Laminating plastics (sheets, rods & tubes), Reinforcing; Applications of Plastics.

MODERN MACHINING PROCESSES: Introduction – comparison with traditional machining; Ultrasonic Machining: principle, Description of equipment, applications; Electric Discharge Machining: Principle, Description of equipment, Dielectric fluid, tools (electrodes), Process parameters, Output characteristics, applications. Wire cut EDM: Principle, Description of equipment, Controlling parameters; applications. Abrasive Jet Machining: principle, description of equipment, application. Laser Beam Machining: principle, description of equipment, application. Electro Chemical Machining: description of equipment, application.

CNC MILLING MACHINES & MACHINE TOOL AUTOMATION: Vertical and horizontal machining center: Constructional features. Axis identification, Electronic control system. Automatic tool changer and tool magazine. CNC programming: Preparatory functions (G code), miscellaneous functions (M code). Part programming including subroutines and canned cycles. Principles of computer aided part programming. Introduction and Need; (A) Single spindle automates, transfer lines. (B) Elements of control system, Limit switches. Proximity switches, Block diagram for feedback and servo control system, Introduction to PLC, Block diagram of PLC.

SPECIAL PURPOSE MACHINES (SPM) & MAINTENANCE OF MACHINE TOOLS: Concept, General elements of SPM, Productivity improvement by SPM, Principles of SPM design. Types of maintenance, Repair cycle analysis, Repair complexity, Maintenance manual. Maintenance records, Housekeeping. Introduction to Total Productive Maintenance (TPM).

E. TEXT BOOKS

T1.Production Technology – HMT, Banglore, Tata Mc-Graw Hill
T2.CNC machines – Pabla B. S. & M. Adithan, New Age international limited.
T3.Non conventional Machining – P. K. Mistra, NarvasaPublishining House
T4.Manufacturing Processes – Begman& Amsted, John Willey and Sons.

F. REFERENCE BOOKS

R1.Advanced manufacturing technology – David L. Goetsch
R2.Exploring Advanced Manufacturing Technologies – Stephen F. Krar& Arthur Gil, Industrial Press

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Know the Operation and control of different advanced machine tools and equipment's.	3			3						3	2	2
[CO2]	Produce jobs as per specified requirements by selecting the specific machining process.		3	3								3	3
[CO3]	Develop the mind set for modern trends in manufacturing and automation.		3								3	2	2
[CO4]	Identify the different fabrication methods viz., sheet forming, blow moulding, laminating and reinforcing of plastics.	3			3						3	3	3
[CO5]	Know different non-traditional machining processes, CNC milling machines, special purpose machines.		3	3								3	
[CO6]	Work as maintenance engineer		3	3								3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Theory of Machines and Mechanisms

Code: DIP14107

3 Credits | Semester V

A. Introduction:

- To understand different types of cams and their motions and also to draw cam profiles for various motions.
- To understand the mechanism of various types of drives available for transmission of power.
- To understand the design of Brakes, Dynamometers, Bearings and Clutches and their function and working.
- To understand the need for balancing of masses in the same plane.
- To know different types of governors.

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Know different machine elements and mechanisms.
[CO 2] Understand Kinematics and Dynamics of different machines and mechanisms.
[CO 3] Select Suitable Drives and Mechanisms for a particular application.
[CO 4] Appreciate concept of balancing and Vibration.
[CO 5] Develop ability to come up with innovative ideas.
[CO 6] Understand different types of cams and their motions and also draw cam profiles for various Motions

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

CAMS AND FOLLOWERS: Concept; Definition and application of Cams and Followers; Classification of Cams and Followers; Different follower motions and their displacement diagrams like uniform velocity, SHM, uniform acceleration and Retardation; Drawing of profile of radial cam with knife-edge with and without offset with reciprocating motion (graphical method). Drawing of profile of radial cam with roller follower with and without offset with reciprocating motion (graphical method).

POWER TRANSMISSION: Types of Drives – Belt, Chain, Rope, Gear drives & their comparison; Belt Drives - flat belt, V– belt & its applications; Material for flat and V-belt; Angle of lap, Belt length. Slip and Creep. Determination of Velocity Ratio, Ratio of tight side and slack side tension. Centrifugal tension and Initial tension; Condition for maximum power transmission (Simple numericals); Chain Drives –

Advantages & Disadvantages; Selection of Chain & Sprocket wheels. Methods of lubrication; Gear Drives – Spur gear terminology. Types of gears and gear trains, their selection for different applications. Train value & Velocity ratio for compound, reverted and simple epicyclic gear train. Methods of lubrication. Law of gearing. Rope Drives – Types, applications, advantages & limitations of Steel ropes.

FLYWHEEL AND GOVERNORS: Flywheel - Concept, function and application. Turning moment diagram for single cylinder 4-Stroke I.C. Engine (no Numericals). Coefficient of fluctuation of energy, Coefficient of fluctuation of speed and its significance. Governors - Types and explanation with neat sketches (Centrifugal, Watt and Porter); Concept, function and applications & Terminology of Governors. Comparison between Flywheel and Governor.

BRAKES, DYNAMOMETERS, CLUTCHES & BEARINGS: Function of brakes and dynamometers; Types of brakes and Dynamometers, Comparison between brakes and dynamometers. Construction and working of i) shoe brake, ii) Band Brake, iii) Internal expanding shoe brake iv) Disc Brake; Concept of Self Locking & Self energizing brakes; Numerical problems to find braking force and braking torque for shoe & band brakes; Construction and working of i) Rope Brake Dynamometer, ii) Hydraulic Dynamometer, iii) Eddy current Dynamometers. Clutches- Uniform pressure and Uniform Wear theories. Function of Clutch and its application; Construction and working of i) Single plate clutch, ii) Multiplate clutch, iii) Centrifugal Clutch iv) Cone clutch and v) Diaphragm clutch. (Simple numericals on single and Multiplate clutch); Bearings – i) Simple Pivot, ii) Collar Bearing, iii) Conical pivot. Torque & power lost in friction (no derivation). Simple numerical

BALANCING & VIBRATIONS: Concept of balancing. Balancing of single rotating mass; Graphical method for balancing of several masses revolving in same plane; Concept and terminology used in vibrations, Causes of vibrations in machines; their harmful effects and remedies

E. TEXT BOOKS

T1.Theory of machines – S.S .Rattan ,Tata McGraw-Hill publications.
T2.Theory of machines – R.K.Bansal ,Laxmi publications
T3.Theory of machines – R.S. Khurmi&J.K.Gupta ,S.Chand publications.

F. REFERENCE BOOKS

R1.Dynamics of Machines – J B K Das, Sapna Publications.
R2.Theory of machines – Jagdishlal, Bombay Metro – Politan book Ltd.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Know different machine elements and mechanisms.	3			3						3	3	
[CO2]	Understand Kinematics and Dynamics of different machines and mechanisms.	3	3								3		
[CO3]	Select Suitable Drives and Mechanisms for a particular application.	3	3		3							2	
[CO4]	Appreciate concept of balancing and Vibration.	3	3								3		
[CO5]	Develop ability to come up with innovative ideas.	3		3								2	
[CO6]	Understand different types of cams and their motions and also draw cam profiles for various Motions	3	3								3		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Industrial Engineering & Management

Code:DIP15231

3 Credits | Semester V

A. Introduction:

- To take the right decisions to optimize resources utilization by improving productivity of the Lands, Buildings, People, Materials, Machines, Money, Methods and Management effectively.
- To eliminate unproductive activities under the control of the Management, Supervisor, worker and the Design of Products and Processes.
- To use the Charts to record the Activities of the people, materials and Equipment.

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Explain the different types of layout and plant maintenance with safety.
[CO 2] List and explain the need of method study and work measurements.
[CO3] Explain the production planning and quality control, and its functions.
[CO 4] Understand the basic principles, approaches and functions of management and identify Concepts to specific situations.
[CO 5] List and explain the different financial sources and methods of inventory management.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

PLANT ENGINEERING & PLANT SAFETY: Plant; Selection of site of industry; Plant layout; Principles of a good layout; Types; Process; Product and Fixed position; Techniques to improve Layout; Principles of Material handling equipment. Plant maintenance; Importance; Break down maintenance; Preventive maintenance and Scheduled maintenance. Importance; Accident: Causes and Cost of an Accident, Accident Proneness, Prevention of Accidents; Industrial disputes; Settlement of Industrial disputes; Collective bargaining; Conciliation. Mediation; Arbitration; Indian Factories Act 1948 and its provisions related to health, welfare and safety.

WORK STUDY, METHOD STUDY & WORK MEASUREMENT: Productivity; Standard of living. Method of improving Productivity. Objectives; Importance of good working conditions. Definition; Objectives; Selection of a job for method study. Basic procedure for conduct of Method study. Tools used; Operation process chart; Flow process chart; Two handed process chart; Man Machine chart; String diagram and flow diagram. Definition; Basic procedure in making a time study; Employees rating factor.

Application of time allowances: Rest, Personal, Process, Special and Policy allowances; Calculation of standard time; Numerical Problems. Calculation of standard time; Numerical Problems; Basic concept of production study; Techniques of Work Measurement. Ratio delay study; Synthesis from standard data; Analytical estimating and Pre determined Motion Time System (PMTS).

PRODUCTION PLANNING AND CONTROL & QUALITY CONTROL: Introduction; Major functions of Production Planning and Control; Pre planning. Methods of forecasting; Routing and Scheduling; Dispatching and Controlling; Concept of Critical Path Method (CPM). Types of Production: Mass Production, Batch Production and Job Order Production; Characteristics. Economic Batch Quantity (EBQ); Principles of Product and Process Planning; Make or Buy decision; Numerical problems. Definition; Objectives; Types of Inspection. First piece, Floor and Centralized Inspection; Advantages and Disadvantages; Statistical Quality Control. Types of Measurements; Method of Variables; Method of Attributes; Uses of X, R, p and c charts; Operating Characteristics curve (O.C curve). Sampling Inspection; Single and Double Sampling plan; Concept of ISO 9001:2008 Quality Management System Registration/Certification procedure; Benefits of ISO to the organization.

PRINCIPLES OF MANAGEMENT & PERSONNEL MANAGEMENT: Definition of Management; Administration; Organization; F.W. Taylor's and Henry Fayol's Principles of Management; Functions of Manager; Types of Organization: Line, Staff, Taylor's Pure functional types; Line and staff and committee type; Directing; Leadership; Styles of Leadership; Qualities of a good leader; Motivation; Positive and Negative Motivation; Modern Management Techniques; Just In Time; Total Quality Management (TQM); Quality circle; Zero defect concept; 5S Concept; Management Information Systems. Responsibility of Human Resource Management; Selection Procedure; Training of Workers. Apprentice Training; On the Job training and Vestibule School Training; Job Evaluation and Merit Rating. Objectives and Importance; Wages and Salary Administration; Components of Wages; Wage Fixation. Type of Wage Payment: Halsey's 50% Plan, Rowan's Plan and Emerson's efficiency plan; Numerial Problems.

FINANCIAL MANAGEMENT & MATERIAL MANAGEMENT: Fixed and Working Capital; Resources of Capital; Shares Preference and Equity Shares. Debentures; Type of debentures; Public Deposits; Factory Costing: Direct Cost; Indirect Cost. Factory Overhead; Selling Price of a product; Profit; Numerical Problems; Depreciation; Causes; Methods. Straight line, sinking fund and percentage on Diminishing Value Method; Numerical Problems Objectives of good stock control system; ABC analysis of Inventory; Procurement and Consumption cycle; Minimum Stock, Lead Time, Reorder Level, Economic Order Quantity problems; Supply Chain.

E. TEXT BOOKS

T1.Industrial Engineering & Management, S.C. Sharma, Khanna Book Publishing Co. (P) Ltd., Delhi
T2. Industrial Engineering and Management, O.P. Khanna, Revised Edition, Dhanpat Rai Publications (P) Ltd., New Delhi – 110002.
T3.Management, A global perspective, Heinz Weihrich, Harold Koontz, 10th Edition, McGraw Hill InternationalEdition 1994.

F. REFERENCE BOOKS

T4.Essentials of Management, 4th Edition, Joseph L.Massie, Prentice-Hall of India, New Delhi 2004.
T5.Principles and Practices of Management, Premvir Kapoor, Khanna Publishing House, N. Delhi

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Explain the different types of layout and plant maintenance with safety.	3	3									3	2
[CO2]	List and explain the need of method study and work measurements.	3		3								2	
[CO3]	Explain the production planning and quality control, and its functions.	3	3	3								2	1
[CO4]	Understand the basic principles, approaches and functions of management and identify concepts to specific situations.	3	3						2				2
[CO5]	List and explain the different financial sources and methods of inventory management.								2	3			3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject:Computer Aided Design and Manufacturing

Code: DIP15219

3 Credits | Semester V

A. Introduction:

- To understand concepts of drafting and modelling using CAD.
- To understand the need for integration of CAD and CAM.
- To understand the concepts of flexible manufacturing system.

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Develop mathematical models to represent curves and surfaces and Model engineering components using solid modeling techniques.
[CO2] Understand geometric transformation techniques in CAD.
[CO3] Develop programs for CNC to manufacture industrial components.
[CO4] Understand the application of computers in various aspects of Manufacturing viz., Design.
[CO5] Proper planning, Manufacturing cost, Layout & Material Handling system.
[CO6] Utilize Flexible manufacturing system tools.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

FUNDAMENTALS OF CAD/CAM&GEOMETRIC MODELING: Automation; Design process; Application of computers for design; Benefits of CAD; Computer configuration for CAD applications; Design workstation; Graphic terminal; CAD Software: Definition of system software and application software; CAD database and structure. 3D-Wire frame modeling; Wire frame entities and their definitions; Interpolation and Approximation of curves;. Concept of Parametric and Non-parametric representation of curves; Curve fitting techniques

SURFACE MODELING: Algebraic and Geometric form; Parametric space of surface; Blending functions; Parametrization of surface patch; Subdividing; Cylindrical surface; Ruled surface; Surface of revolution; Spherical surface; Composite surface; Bezier surface; Solid Modelling: Definition of cell composition and spatial occupancy enumeration; Sweep representation; Constructive solid geometry; Boundary representations.

NC CONTROL PRODUCTION SYSTEMS: Numerical control. Elements of NC system; NC part programming. Methods of NC part programming. Manual part programming. Computer assisted part programming. Post processor; Computerized part program.

GROUP TECHNOLOGY: Part families; Parts classification and coding, Production analysis; Machine cell design; Computer aided process planning: Retrieval type and Generative type; Machine ability data systems; MRP and its Benefits.

FLEXIBLE MANUFACTURING SYSTEM: F.M.S equipment; Layouts. Analysis methods and benefits; Computer aided quality control. Automated inspection: Off-line, On-line. Automated inspection: Contact, Non-contact. Coordinate measuring machines. Machine vision; CIM system and Benefits.

E. TEXT BOOKS

T1.CAD/CAM Principles and Applications, P.N.Rao, Tata McGraw-Hill
T2.Computer Aided Design and Manufacturing, Groover M.P. &Zimmers Jr, Prentice hall of India

F. REFERENCE BOOKS

T3.CAD/CAM/CIM, Radha Krishna P. &Subramanyam, Wiley Eastern Ltd

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Develop mathematical models to represent curves and surfaces and Model engineeringcomponents using solid modelling techniques	3		3							3	2	
[CO2]	Understand geometric transformation techniques in CAD.	3	3	3								1	
[CO3]	Develop programs for CNC to manufacture industrial components.	3	3										
[CO4]	Understand the application of computers in various aspects of Manufacturing viz., Design.	3	3		3								
[CO5]	Proper planning, Manufacturing cost, Layout & Material Handling system.	3	3										2
[CO6]	Utilize Flexible manufacturing system tools.				3						3		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Automobile Engineering

Code:DIP15138

3 Credits | Semester V

A. Introduction:

- To understand the basic structure and components of an automobile.
- To understand the concepts of cooling and lubricating systems.
- To understand the concepts of Ignition and transmission and steering systems.
- To understand the classification and necessity of suspension system.
- To identify different special vehicles.

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Identify the components of an automobile with their working
[CO2]Explain the concepts of cooling and lubricating systems.
[CO3]Identify different suspension systems and their applications.
[CO4]Explain the concepts of Ignition and Transmission and steering systems.
[CO5]Differentiate the special vehicles according to the usage.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

INTRODUCTION TO BASIC STRUCTURE OF AN AUTOMOBILE: Basic engine components; Cylinder block; Cylinder head. Gaskets; cylinder liners, types of cylinder liners; Piston and piston pin. Piston rings, types of piston rings; Connecting rod; Crank shaft. Cam shaft; Crankcase; Engine valves; Flywheel and Governor.

COOLING AND LUBRICATION SYSTEM & FUEL FEED SYSTEM: The necessity of cooling system; Types of cooling system-air cooling and water cooling; Air cooling system. Types of water cooling system –Thermosyphon system and pump circulation system; Advantages and disadvantages of air-cooling and water cooling systems. The components of water cooling system –fan, radiator, pump and thermostat; The necessity of lubrication system; S.A.E rating of lubrication system; Types of lubrication system; Petrol lubrication and high pressure lubrication system. Conventional fuels and alternative fuels: Cetane and octane numbers; Types of carburettors. Working of simple carburettor; Multi point and single

point fuel injection systems, Different fuel transfer pumps. Working of S.U electrical and A.C mechanical pump; Fuel filters; Fuel injection pump; Fuel injectors.

IGNITION SYSTEM &TRANSMISSION AND STEERING SYSTEM: Introduction to ignition system; Battery Ignition systems and magneto Ignition system. Electronic Ignition system; Construction and working of lead acid battery; Elements of charging system. Elements of starting system; Types of lights used in the automobile. General arrangement of clutch; Principle of friction clutches. Constructional details of Single plate clutch; Constructional details of multi-plate clutch; Constructional details of centrifugal clutch. Necessity for gear ratios in transmission, Types of gearboxes. Working of sliding mesh gearbox; Working of constant mesh gearbox. Working of propeller shaft Working of propeller shaft; Working of universal joint; Working of differential; Types of rear axle. Purpose of front axle; Necessity of steering system; Caster, camber and king pin inclination; Rack and pinion steering system; Power steering.

SUSPENSION SYSTEM: Necessity of suspension system; Torsion bar suspension systems. Leafspring and coil spring suspension system; Independent suspension for front wheel and rear wheel. Working of telescopic shock absorber; Functions of brakes; Types of brakes; Working of internal expanding brake; Working of disc brake.

SPECIAL VEHICLES: Introduction to Special vehicles. Tractor; Motor grader; Scrappers. Excavators; Duper trucks.

E. TEXT BOOKS

T1.Automobile Engineering Vol I, II, Kirpal Singh, Standard Publishers Distributors, Delhi. 2012.
T2.Automobile Mechanics, A.K. Babu, S.C. Sharma, Khanna Publications, New Delhi
T3.Automotive Mechanics: Principles and Practices, Joseph Heitner, East West Press
T4.Automotive Mechanics, S. Srinivasan, 2nd Edition, Tata McGraw Hill

F. REFERENCE BOOKS

R1.Automobile Engineering Vol I and Vol II, K. M. Gupta, Umesh Publications.
R2.Automotive Engineering, Jain and Asthana, Tata McGraw Hill.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Identify the components of an automobile with their working	3	3									2	
[CO2]	Explain the concepts of cooling and lubricating systems.	3	3	3									
[CO3]	Identify different suspension systems and their applications.		3		3								
[CO4]	Explain the concepts of Ignition and Transmission and steering systems.	3	3								3	1	1
[CO5]	Differentiate the special vehicles according to the usage.	3	3										

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Hybrid Vehicles

Code: DIP15229

3 Credits | Semester V

A. Introduction:

- To understand the basics of electric vehicle history and components.
- To understand properties of batteries.
- To understand the electrical machine properties and classifications.
- To understand the properties of electric vehicle drive systems
- To understand the concepts of hybrid electric vehicles.

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Understand the basics of electrical vehicle history and components.
[CO 2]Understand the properties of batteries.
[CO 3]Understand the electrical machine properties and classifications.
[CO 4] Understand the properties of electrical vehicle drive systems.
[CO 5] Understand the concepts of hybrid electric vehicles.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

ELECTRIC VEHICLES: Introduction; History of Hybrid and Electric Vehicles. Social and Environmental importance of Hybrid and Electric Vehicles. Components, Vehicle mechanics: Roadway fundamentals, Vehicle kinetics. Dynamics of vehicle motion; Propulsion System Design.

BATTERY: Basics; Types; Parameters: Capacity, Discharge rate, State of charge, State of Discharge, Depth of Discharge; Technical characteristics, Battery pack Design, Properties of Batteries.

DC & AC ELECTRICAL MACHINES: Motor and Engine rating; Requirements. DC machines; Three phase A/c machines. Induction machines; Permanent magnet machines. Switched reluctance machines.

ELECTRIC VEHICLE DRIVE TRAIN: Transmission configuration; Components: Gears, Differential, Clutch, Brakes; Regenerative braking, Motor sizing; Fuel efficiency analysis.

HYBRID ELECTRIC VEHICLES: Types: Parallel, Series, Parallel and Series configurations; Drivetrain; Sizing of components; Basics of Micro, Mild, Mini, Plug-in and Fully hybrid

E. TEXT BOOKS

T1.Electric & Hybrid Vehicles – A.K. Babu, Khanna Publishing House, New Delhi, 2018
T2.Electric & Hybrid Vehicles – Design Fundamentals - Iqbal Hussain, Second Edition, CRC Press, 2011.
T3.Electric Vehicle Technology Explained - James Larminie, John Wiley & Sons, 2003.

F. REFERENCE BOOKS

R1.Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals - MehrdadEhsani, YiminGao, Ali Emadi, CRC Press, 2010.
R2.Electric Vehicle Battery Systems - Sandeep Dhameja, Newnes, 2000.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Understand the basics of electrical vehicle history and components.	3	3	2								1	
[CO2]	Understand the properties of batteries.	3	3									3	
[CO3]	Understand the electrical machine properties and classifications.	3	3										
[CO4]	Understand the properties of electrical vehicle drive systems.	3	3										2
[CO5]	Understand the concepts of hybrid electric vehicles.	3	3									2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject:Industrial Robotics & Automation

Code:DIP15232

3 Credits | Semester V

A. Introduction:

- To introduce the basic concepts, parts of robots and types of robots.
- To make the student familiar with the various drive systems for robot, sensors and their applications in robots and programming of robots.
- To select the robots according to its usage.
- To discuss about the various applications of robots, justification and implementation of robot.
- To conceptualize automation and understand applications of robots in various industries.

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B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Explain the robot anatomy, classification, characteristics of robot, advantages and disadvantages.

[CO 2]Explain the various robotic actuators on hydraulic, pneumatic and electrical drives.

[CO 3]Explain about various types of sensors and concepts on robot vision system.

[CO 4] Explain the concepts of robot programming languages and various methods of robot programming.

[CO 5] Explain the various applications of robots.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

FUNDAMENTALS OF ROBOTICS: Introduction; Definition; Robot anatomy (parts) and its working; Robot Components: Manipulator, End effectors. Construction of links, Types of joints; Classification of robots; Cartesian, Cylindrical, Spherical, Scare. Vertical articulated; Structural Characteristics of robots; Mechanical rigidity. Effects of structure on control work envelope and work Volume; Robot work Volumes, comparison; Advantages and disadvantages of robots.

ROBOTIC DRIVE SYSTEM AND CONTROLLER: Actuators; Hydraulic, Pneumatic and Electrical drives; Linear actuator; Rotary drives. AC servo motor; DC servo motors and Stepper motors; Conversion between linear and rotary motion. Feedback devices; Potentiometers; Optical encoders; DC tachometers; Robot controller; Level of Controller. Open loop and Closed loop controller; Microprocessor based

control system; Robot path control. Point to point, Continuous path control and Sensor based path control; Controller programming.

SENSORS & INTRODUCTION TO MACHINE VISION: Requirements of a sensor; Principles and Applications of the following types of sensors: Position sensors (Encoders, Resolvers, Piezo Electric); Range sensors (Triangulation Principle, Structured lighting approach); Proximity sensing; Force and torque sensing. Robot vision system (scanning and digitizing image data); Image processing and analysis; Cameras (Acquisition of images); Videocon camera (Working principle & construction); Applications of Robot vision system: Inspection, Identification, Navigation & serving.

ROBOT KINEMATICS AND ROBOT PROGRAMMING: Forward Kinematics; Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional); Deviations and Problems. Teach Pendant Programming; Lead through programming; Robot programming Languages; VAL Programming; Motion Commands; Sensor Commands; End effecter commands; and Simple programs.

AUTOMATION&INDUSTRIAL APPLICATIONS: Basic elements of automated system, advanced automation functions, levels of automation. Application of robots in machining; welding; assembly and material handling.

E. TEXT BOOKS

T1.Introduction to Robotics: Analysis, Systems, Applications – Saeed B. Niku, Pearson Education Inc. New Delhi 2006.
T2.Industrial Robotics: Technology, Programming and Applications – M.P. Groover, Tata McGraw Hill Co, 2001.
T3.Robotics Control, Sensing, Vision and Intelligence – Fu.K.S. Gonzalz.R.C and Lee C.S.G, Mc-Graw Hill Book Co, 1987.
T4.Robotics for Engineers – YoramKoren, McGraw Hill Book Co, 1992.
T5.A Text book on Industrial Robotics – Ganesh S. Hedge, Laxmi Publications Pvt. Ltd., New Delhi, 2008.

F. REFERENCE BOOKS

T6.Robotics Technology and Flexible Automation – S.R. Deb &Sankha Deb, Tata McGraw-Hill, 2010.
T7.Elements of Robotics Process Automation, Mukherjee, Khanna Publishing House, Delhi, 2018

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Explain the robot anatomy, classification, characteristics of robot, advantages anddisadvantages.	3	3										
[CO2]	Explain the various robotic actuators on hydraulic, pneumatic and electrical drives.	3	3										
[CO3]	Explain about various types of sensors and concepts on robot vision system.	3	3								3		
[CO4]	Explain the concepts of robot programming languages and various methods of robotprogramming.	3	3										
[CO5]	Explain the various applications of robots.	3	3										

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Power Plant Engineering

Code: DIP15139

3 Credits | Semester V

A. Introduction:

- To understand the present scenario of power in India.
- To recognize various load terminologies used in power plants.
- To understand hydro working principles
- To understand working of Diesel, Gas and Nuclear power plants.
- To understand the issues and safety precautions in power plants.

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B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Familiarised with the present and future power scenario of India.
[CO 2]Enlist various load terminologies in power plants.
[CO 3]Working and classifications in hydro power plant.
[CO 4] Working principles of Diesel, Gas and Nuclear power plants.
[CO 5] Understand the issues and necessity of safety concepts of power plants.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

INTRODUCTION TO POWER PLANT: Introduction to power plant. Indian Energy scenario in India; Location of power plant. Choice of Power plant; Classification of power plants.

ECONOMICS OF POWER PLANT: Terminology used in power plant: Peak load, Base load, Load factor, Load curve. Various factor affecting the operation of power plant. Methods of meeting the fluctuating load in power plant. Load sharing- cost of power-tariff methods; Performance and operating characteristics of power plant.

HYDRO POWER PLANT: Introduction to Hydroelectric power plant; Rainfall, Runoff and its measurement, Hydrograph, flow duration curve. Selection of sites for hydroelectric power plant; General

layout of Hydroelectric power plant and its working. Classification of the Plant-Run off riverplant, storage river plant, pumped storage plant. Advantages and disadvantages of hydroelectric power plant.

DIESEL AND GAS TURBINE PLANT &NUCLEAR POWER PLANT: The layout of diesel power plant; Components and the working of diesel power plant. Advantages and disadvantages of diesel power plant; Gas turbine power Plant-Schematic diagram, components and its working; Combined cycle power generation- Combined gas and steam turbine power plant operation (only flow diagram). Introduction; Nuclear Power-Radio activity-Radioactive charge-types of reactions. Working of a nuclear power plant; Thermal fission Reactors- PWR, BWR and gas cooled reactors. Advantages and Disadvantages of Nuclear power plant.

ENVIRONMENTAL IMPACT OF POWER PLANT & POWER PLANT: Social and Economic issues of power plant; Greenhouse effect. Acid precipitation-Acid rain, Acid snow, Dry deposition, Acid fog; Air, water, Thermal pollution from power plants. Radiations from nuclear power plant effluents. Plant safety concept; Safety policy to be observed in power plants. Safety practices to be observed in boiler operation; Safety in oil handling system. Safety in Chemical handling system; Statutory provision related to boiler operation.

E. TEXT BOOKS

T1.Power plant Engineering-P.K. Nag 4th edition, Tata McGraw Hill Education, 2014.
T2.Power plant Engineering – Frederick T. Morse, Litton Educational Publishing Inc. 1953.
T3.Power Plant Engineering – P.C. Sharma, S.K.Kataria& sons, 2009.

F. REFERENCE BOOKS

T4.Power System Engineering – R.K. Rajput, Firewell Media,2006.
T5.A Course in Power Plant Engineering – Subhash C. Arora, S. Domakundwar, Dhanpat Rai, 1984.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Familiarised with the present and future power scenario of India.	3									3		3
[CO2]	Enlist various load terminologies in power plants.	3	3									3	
[CO3]	Working and classifications in hydro power plant.	3	3	3								2	
[CO4]	Working principles of Diesel, Gas and Nuclear power plants.	3	3	3								2	
[CO5]	Understand the issues and necessity of safety concepts of power plants.	3									3		3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Mechatronics

Code:DIP15140

3 Credits | Semester V

A. Introduction:

- To understand the basic concepts and characteristics of measurement systems.
- To learn various types of sensors and transducers various mechanical, electrical and pneumatic actuation systems.
- To learn various mechanical, electrical and pneumatic actuation systems.
- To learn the concepts of digital communications and develop PLC programs.
- To evaluate the performance of mechatronic systems.

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Describe about various types of sensors and transducers.
[CO2]Explain the various mechanical, electrical and pneumatic actuation systems.
[CO3]Explain the basic mathematical building blocks for mechanical, electrical, thermal and fluid actuation system and its interfacing of input/output requirements.
[CO4] Explain the basic PLC architecture and PLC programming concepts.
[CO5] Describe the design examples of mechatronics system. Explain the condition monitoring of production systems using sensors

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

INTRODUCTION TO MECHATRONICS&MEASUREMENT SYSTEM TERMINOLOGY: Mechatronics; Importance of Mechatronics; Systems: Measurement systems; Control systems and their types. Closed-loop control System; Automatic water level controller; Sequential controllers-washing machine. Displacement, Position & Proximity Sensors; Velocity and Motion Sensors; Force Sensors. Fluid Pressure Sensors; Flow Sensors; Liquid Level Sensors; Temperature Sensors; Light Sensors; Selection of Sensors.

MECHANICAL ACTUATION SYSTEMS, **ELECTRICAL ACTUATION SYSTEMS**&**PNEUMATIC & HYDRAULIC SYSTEMS:** Types of motion; Freedom and constraints; Loading; Gear Trains; Pawl & Ratchet; Belt & Chain drives. Bearings: Selection, Ball & Roller bearings; Mechanical aspects of motor selection. Switches & Relays; Solenoids; D.C Motors; A.C.Motors; Stepper Motors: Specifications and Control of stepper motors; Servomotors: D.C Servomotor and A.C Servomotor Power supplies; DCV; PCV; Cylinders; Rotary actuators.

MATHEMATICAL MODEL, **SYSTEM MODEL**&**INPUT/OUTPUT SYSTEMS:** Introduction to Mathematical model; Mechanical System building blocks. Electrical System building blocks; Fluid System building blocks; Thermal System building blocks. Engineering Systems: Rotational, Translational Systems; Electro-Mechanical System; Hydro-Mechanical System. Interfacing; Input/output ports; Interface requirements: Buffers, Handshaking, Polling and interrupts, Serial interfacing. Introduction to PIA; Serial communications interface; Example of interfacing of a seven-segment display with a decoder.

PROGRAMMABLE LOGIC CONTROLLER (PLC): Definition; Basic block diagram and structure of PLC;Input/Output processing. PLC Programming: Ladder diagram, its logic functions, Latching and Sequencing; PLC mnemonics; Timers. Internal relays and Counters; Shift registers; Master and Jump Controls. Data handling; Analog input/output; Selection of PLC.

DESIGN EXAMPLES & ADVANCED APPLICATIONS IN MECHATRONICS &SENSORS FOR CONDITION MONITORING SYSTEMS OF PRODUCTION SYSTEMS: Design process stages; Traditional Vs Mechatronics designs; Possible design solutions: Timed switch, Wind-screen wiper motion, Bath room scale; Case studies of Mechatronics systems: A pick-and-place robot, Car park barrier, Car engine management system, Automatic Camera and Automatic Washing Machine only. Examples of Monitoring methods: Vibration monitoring, Temperature monitoring, Wear behavior monitoring; Mechatronics control in automated manufacturing: Monitoring of Manufacturing processes, On-line quality monitoring, Model based systems, Hardware in-the-loop simulation, Supervisory control in manufacturing inspection, Integration of heterogeneous systems.

E. TEXT BOOKS

T1.Mechatronics – W. Bolton, Pearson Education India.
T2.A Text Book on Mechatronics – R.K.Rajput, S.Chand& Co, New Delhi.
T3.Mechatronics – M.D.Singh& Joshi, Prentice Hall of India.
T4.Mechatronics – HMT, Tata McGraw Hill, New Delhi.

F. REFERENCE BOOKS

R1.Mechatronics System – Devadas Shetty, PWS Publishing
R2.Exploring Programmable Logic Controllers with applications – Pradeep Kumar Srivatsava, BPB Publications

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Describe about various types of sensors and transducers.	3	3										
[CO2]	Explain the various mechanical, electrical and pneumatic actuation systems.		3	3									
[CO3]	Explain the basic mathematical building blocks for mechanical, electrical, thermal and fluid actuation system and its interfacing of input/output requirements.	3		3									
[CO4]	Explain the basic PLC architecture and PLC programming concepts.	3		3									
[CO5]	Describe the design examples of mechatronics system. Explain the condition monitoring of production systems using sensors	3	3										1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Renewable Energy Technology

Code:DIP15251

3 Credits | Semester V

A. Introduction:

- The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:
- Maintain the renewable energy technology equipment.

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Maintain ocean thermal energy technologies
[CO 2]Maintain the optimised working of solar PV and CS power plants.
[CO 3]Maintain the optimised working of large wind power plants
[CO 4] Maintain the optimised working of small wind turbines.
[CO 5] Maintain the optimised working of biomass-based power plants.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

OCEAN ENERGY TECHNOLOGIES: Ocean energy map of India and its implications. Specification, Construction and working of the following: ocean energy technologies. Tidal power technologies, Wave power technologies, Marine current technologies. Ocean Thermal Energy Conversion (OTEC) technologies.

SOLAR PV AND CONCENTRATED SOLAR POWER PLANTS: Solar Map of India: Global solar power radiation, Solar PV. Concentrated Solar Power (CSP) plants, construction and working of: Power Tower, Parabolic. Trough, Parabolic Dish, Fresnel Reflectors, Solar Photovoltaic (PV) power plant: components layout, Construction & working, Rooftop solar PV power system

LARGE WIND POWER PLANTS: Wind Map of India: Wind power density in watts per square meter. Lift and drag principle; long path theory, Geared type wind power plants: components, layout and working. Direct drive type wind power plants: components, layout and working, Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG). Wound Rotor Induction Generator (WRIG), Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), wound rotor synchronous generator (WRSG), permanent magnet synchronous generator (PMSG).

SMALL WIND TURBINES: Horizontal axis small wind turbine: direct drive type, components and working. Horizontal axis small wind turbine: geared type, components and working, Vertical axis small wind turbine: direct drive and geared, components and working. Types of towers and installation of small wind turbines on roof tops and open fields, Electric generators used in small wind power plants.

BIOMASS-BASED POWER PLANTS: Properties of solid fuel for biomass power plants: bagasse, wood chips, rice husk, municipal waste. Properties of liquid and gaseous fuel for biomass power plants: Jatropha, bio-diesel gobar gas. Layout of a Bio-chemical based (e.g. biogas) power plant, Layout of a Thermo-chemical based (e.g. Municipal waste) power plant. Layout of a Agro-chemical based (e.g. bio-diesel) power plant.

E. TEXT BOOKS

T1.Neill, Simon P.; Hashemi, M. Reza: Fundamentals of Ocean Renewable Energy: Generating Electricity from the Sea, Academic Press, ISBN:978-0-12-810448-4.
T2. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd, Renewable Energy Systems, Pearson Education New Delhi , ISBN: 9789332586826,
T3.Rachel, Sthuthi, Earnest, Joshua; -Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9
T4.Deambi, Suneel: From Sunlight to Electricity: a practical handbook on solar photovoltaic application; TERI, New Delhi ISBN:9788179935736
T5.Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304

F. REFERENCE BOOKS

T6.Wizelius, Tore, Earnest, Joshua - Wind Power Plants and Project Development, PHI Learning, New Delhi, ISBN:978-8120351660
T7.Kothari, D.P. et aL: Renewable Energy Sources and Emerging Technologies, PHI Learning, Delhi, ISBN: -978-81-203-4470-9
T8. Bhadra, S.N., Kastha, D., Banerjee, S, Wind Electrical Systems installation; Oxford UniversityPress, New Delhi, ISBN: 9780195670936.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Maintain ocean thermal energy technologies	3		3								3	3
[CO2]	Maintain the optimised working of solar PV and CS power plants.	3	3	3								3	3
[CO3]	Maintain the optimised working of large wind power plants	3	3									3	
[CO4]	Maintain the optimised working of small wind turbines.	3	3	3								3	
[CO5]	Maintain the optimised working of biomass-based power plants	3	3										

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Operations Research

Code: DIP16256

3 Credits | Semester V

A. Introduction:

- To provide a broad and in depth knowledge of a range of operation research models.
- To understand the techniques, which can be apply to a variety of industrial applications.

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Identify the elements of operations management and various transformation processes to enhance productivity and competitiveness.

[CO2] Understandingthe problems as networks and graphs.

[CO3] Apply different mathematical models and the solution to solve optimisation problems.

[CO4] Analyze linear programming (LP) models for shortest path, maximum flow, minimal spanning tree, critical path, minimum cost flow, and transshipment problems.

[CO5] Evaluate the problems using special solution algorithms.

[CO6] Plan and implement suitable materials handling principles and practices in the operations.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

DEVELOPMENT: Definition, Characteristics and phase of Scientific Method, Types of models- General methods for solving operations research models.

ALLOCATION: Introduction to linear programming formulation, graphical solution, Simplex Method, artificial variable technique, Duality principle. Sensitivity analysis.

TRANSPORTATION PROBLEM FORMULATION OPTIMAL SOLUTION: Unbalanced transportation problems, Degeneracy, Assignment problem, Formulation optimal solution.

SEQUENCING: Introduction, Terminology, notations and assumptions, problems with n-jobs and two machines, Brand Management. Optimal sequence algorithm, problems with n-jobs and three machines.

THEORY OF GAMES: Introduction, Two-person zero-sum games, The Maximum –Minimax principle, Games without saddle points – Mixed Strategies, 2 x n and m x 2 Games – Graphical solutions,, Dominance property, Use of L.P. to games.

A. TEXT BOOKS

T1. Linear Programming and Network Flows(by Mokhtar S. Bazaraa, John J. Jarvis, HanifD.Sherali)
T2. Operations Research: Applications and Algorithms (by Wayne L. Winston)
T3.Nonlinear Programming: Theory and Algorithms 3rd Edition (by Mokhtar S. Bazaraa, Hanif D.Sherali C. M. Shetty)

F. REFERENCE BOOKS

R1.Hamdy A. Taha, Operations Research: an introduction, Pearson Education.
R2. J.K. Sharma, Operations. Research: theory and application, Macmillan Publishers.
R3. Frederick S. Hillier and Gerald J Lieberman, Introduction to Operations Research: concept and cases, Tata McGraw-Hill.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Identify the elements of operations management and various transformation processes to enhance productivity and competitiveness.						1			1			1
[CO2]	Understanding the problems as networks and graphs.						2			2	2		1
[CO3]	Apply different mathematical models and the solution to solve optimisation problems.	1						2					
[CO4]	Analyze linear programming (LP) models for shortest path, maximum flow, minimal spanning tree, critical path, minimum cost flow, and transshipment problems.						3		2				
[CO5]	Evaluate the problems using special solution algorithms.		1						2	3			
[CO6]	Plan and implement suitable materials handling principles and practices in the operations.						3	2					

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Internet of Things

Code:DIP15234

3 Credits | Semester V

A. Introduction:

- To build different solutions in various sectors.
- To learn the fundamentals of the emerging technology.

B. **Course Outcomes:** At the end of the course, students will be able to

[CO1] Identify the factors that contributed to the emergence of IoT.

[CO2] Understand the application areas of IOT ·

[CO3] Apply Arduino to get automations as per requirement.

[CO4] Analyze the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.

[CO5] Evaluate building blocks of Internet of Things and characteristics.

[CO6] Design an IoT device to work with a Cloud Computing infrastructure.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

INTRODUCTION TO INTERNET OF THINGS: Introduction to Internet of Things, Physical Design of IOT,Logical Design of IOT, IOT Enabling Technologies, IOT Levels.

BASICS OF IoT NETWORKING: Communication Protocols, Sensor networks

Domain Specific IOTs: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life St yle.

INTRODUCTION TO ARDUINO PROGRAMMING: Integration of Sensors, Actuators to Arduino

IMPLEMENTATION OF IoT: With Raspberry Pi, Data Handling Analytics

CASE STUDIES DIFFERENT SECTORS: Agriculture, Healthcare, Activity Monitoring

E. TEXT BOOKS

T1. Vijay Madisetti, ArshdeepBahga," Internet of Things A Hands-On- Approach",2014, ISBN:978 0996025515

T2.Dr. JeevaJose , Internet of Things, Khanna Publishing House.

F. REFERENCE BOOKS

R1.Pethuru Raj and Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press.

R2.Adrian McEwen, "Designing the Internet of Things", Wile y Publishers, 2013, ISBN:978- 1-118-43062-0

R3.Daniel Kellmereit, "The Silent Intelligence: The Internet of Things". 2013, ISBN 0989973700

R4.Raj Kamal, Internet of Things: Architecture and Design Principles, McGraw Hill.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Identify the factors that contributed to the emergence of IoT.	2	2		1								3
[CO2]	Understand the application areas of IOT ·		2		2							2	
[CO3]	Apply Arduino to get automations as per requirement.			1	2		2						2
[CO4]	Analyze the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.		2		3							2	
[CO5]	Evaluate building blocks of Internet of Things and characteristics.		2			2						2	
[CO6]	Design an IoT device to work with a Cloud Computing infrastructure.		2	3								2	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: CAD/CAM Lab

Code:DIP15217

1Credits | Semester V

A. Introduction:

- To understand the fundamentals and use CAD.
- To conceptualize drafting and modelling in CAD.
- To interpret the various features in the menu of solid modelling package.
- To synthesize various parts or components in an assembly.
- To prepare CNC programmes for various jobs.

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Explain the 3D commands and features of a CAD software.
[CO 2] Create 3D solid model and find the mass properties of simples solids.
[CO 3] Demonstrate the working of CNC turning and milling machine.
[CO 4] Develop the part program using simulation software for Lathe and Milling.
[CO 5] Assess the part program, edit and execute in CNC turning and machining centre.

C. SYLLABUS

S.No.	Name of Experiment
1	**Introduction** Part modelling; Datum Plane; constraint; sketch; dimensioning; extrude; revolve; sweep; blend; protrusion; extrusion; rib; shell; hole; round; chamfer; copy; mirror; assembly; align; orient.Exercises: 3D Drawings of 1). Geneva Wheel; 2). Bearing Block; 3). Bushed bearing: 4). Gib and Cotter joint; 5). Screw Jack; 6). Connecting Rod: Note: Print the orthographic view and sectional view from the above assembled 3D drawing.
2	Part modelling; Datum Plane; constraint; sketch; dimensioning; extrude; revolve; sweep; blend; protrusion; extrusion; rib; shell; hole; round; chamfer; copy; mirror; assembly; align; orient.Exercises: 3D Drawings of 1). Geneva Wheel; 2). Bearing Block; 3). Bushed bearing: 4). Gib and Cotter joint; 5). Screw Jack; 6). Connecting Rod: Note: Print the orthographic view and sectional view from the above assembled 3D drawing.
3	**CNC Programming and Machining** Introduction; 1). Study of CNC lathe, milling; 2). Study of international standard codes: G-Codes and M-Codes; 3). Format – Dimensioning methods; 4). Program writing – Turning simulator – Milling simulator, IS practice – commands menus; 5). Editing the program in the CNC machines; 6). Execute the program in the CNC machines; Exercises: Note: Print the Program from the Simulation Software and make the Component in the CNC Machine.

4	**CNC Turning Machine** (Material: Aluminium/Acrylic/Plastic rod) Using Linear and Circular interpolation - Create a part program and produce component in the Machine. Using Stock removal cycle – Create a part program for multiple turning operations and produce component in the Machine. Using canned cycle - Create a part program for thread cutting, grooving and produce component in the Machine
5	**CNC Milling Machine** (Material: Aluminium/ Acrylic/ Plastic) Using Linear interpolation and Circular interpolation – Create a part program for grooving and produce component in the Machine. Using canned cycle - Create a part program for drilling, tapping, counter sinking and produce component in the Machine. Using subprogram - Create a part program for mirroring and produce component in the Machine.

D .TEXT BOOKS

T1.Machine Drawing – P.S. Gill S. K. Kataria& Sons, Delhi., 17th Revised edition, 2001.
T2.Mechanical Draughtsmanship - G.L. TamtaDhanpat Rai & Sons, Delhi, 1992.
T3.Inside AutoCAD – D. Raker and H. Rice, BPB Publications, New Delhi, 1985.

F. REFERENCE BOOKS

R1.CAD/CAM/CIM – P. Radhakrishnan, S. Subramaniyan& V. Raju, New Age International Pvt. Ltd., New Delhi, 3rd Edition.
R2.Engineering AutoCAD, A.P. Gautam& Pradeep Jain, Khanna Book Publishing Co., Delhi.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Explain the 3D commands and features of a CAD software.	3		2									
[CO2]	Create 3D solid model and find the mass properties of simples solids.	3	3										
[CO3]	Demonstrate the working of CNC turning and milling machine.	3	3								3		
[CO4]	Develop the part program using simulation software for Lathe and Milling.	3	3								3		
[CO5]	Assess the part program, edit and execute in CNC turning and machining centre.	3		3							3		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Theory of Machines and Mechanisms Lab

Code:DIP15246

- Credits | Semester V

A. Introduction:

- To understand the Ackerman's Steering Gear Mechanism.
- To conceptualize various types of gears.
- To interpret the various various types of gear trains.
- To synthesize various parts of slider, crank and four bar mechanism.
  To understand the problems solving method of displacement diagram, velocity diagram & acceleration diagram of cam follower

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Explain the 3D commands and features of a CAD software.
[CO 2] Create 3D solid model and find the mass properties of simples solids.
[CO 3] Demonstrate the working of CNC turning and milling machine.
[CO 4] Develop the part program using simulation software for Lathe and Milling.
[CO 5] Assess the part program, edit and execute in CNC turning and machining centre.

C. SYLLABUS

S.No.	Name of Experiment
1	Study of Ackerman's Steering Gear Mechanism.
2	To study various types of gears.
3	To study various types of gear trains
4	To draw velocity diagram of slider crank mechanism.
5	To draw acceleration diagram of four bar mechanism.
6	To draw displacement diagram, velocity diagram & acceleration diagram of cam follower

D. Text Book:

T1.Theory of machines – S.S .Rattan ,Tata McGraw-Hill publications.
T2.Theory of machines – R.K.Bansal ,Laxmi publications
T3.Theory of machines – R.S. Khurmi&J.K.Gupta ,S.Chand publications.

F. REFERENCE BOOKS

R1.Dynamics of Machines – J B K Das, Sapna Publications.
R2.Theory of machines – Jagdishlal, Bombay Metro – Politan book Ltd

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Explain the 3D commands and features of a CAD software.	3	3	3									
[CO2]	Create 3D solid model and find the mass properties of simples solids.	3			3								
[CO3]	Demonstrate the working of CNC turning and milling machine.	3		3									
[CO4]	Develop the part program using simulation software for Lathe and Milling.	3	3	3									
[CO5]	Assess the part program, edit and execute in CNC turning and machining centre.	3		3	3								

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject:Summer Internship-II

Code: DIP15244

3 Credits | Semester V

A. Introduction:

- Following are the intended objectives of internship training:
- Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Experience gained from the 'Industrial Internship' in classroom will be use in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job

B. Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Continuous Internal Assessment (CIA)	Internal Examination	30
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

GUIDELINES FOR INTERNSHIP

Summer Internship –II should be undertaken in an industry only

S.No.	Suggested Schedule	Suggested Duration (In weeks)	Activities
1	Summer/winter vacation after 4th Semester	4-6	Inter/Intra Institutional Activities

Subject:Major Project-I

Code: DIP15236

1 Credits | Semester V

A. Introduction: The objective of this course is to prepare students to use applications of the theory and practical learned during the course. It will also help students to develop an industry or research oriented project. This course helps students how to carry out project/studies in the field of interest of the student or as given by the industry.

B.Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	15
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	Completion of Internship during the Summer vacation	

GUIDELINES FOR INTERNSHIP

Major Project-I should be based on real/ live problems of the Industry/Govt./NGO/ MSME/Rural Sector or an innovative idea having the potential of a Startup

ARKA JAIN University
Jharkhand

Syllabus of

Diploma in mechanical Engineering

Semester-VI

ARKAJAIN University, Jharkhand
School of Engineering & IT
Department of Engineering
Faculty – Diploma in Mechanical Engineering (DEME)
Scheme of Study (w.e.f Batch 2020-23)

SEMESTER –I (Group-A)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Communication Skills in English	HSC	3	3	100	70	20	5	5
2	Mathematics-I	BSC	4	4	100	70	20	5	5
3	Applied Physics	BSC	4	4	100	70	20	5	5
4	Applied Chemistry	BSC	4	4	100	70	20	5	5
	Practical								
5.	Engineering Workshop Practice	ESC	2	4	50	35	5	5	5
6.	Applied Physics Lab	BSC	1	2	50	35	5	5	5
7.	Applied Chemistry Lab	BSC	1	2	50	35	5	5	5
8.	Communication Skills in English Lab	HSC	1	2	50	35	5	5	5
	Total		**20**	**25**	**600**	**420**	**100**	**40**	**40**

SEMESTER I (Group-B)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Mathematics -I	BSC	4	4	100	70	20	5	5
2	Fundamentals of Electrical & Electronics Engg.	ESC	4	4	100	70	20	5	5
3	Introduction to IT system	ESC	3	3	100	70	20	5	5
4	Engineering Mechanics	ESC	4	4	100	70	20	5	5
5	Environmental Science	AC	0	2	50	35	10	2.5	2.5
	Practical								
6	Fundamentals of electrical & electronics Engg. Lab	ESC	1	2	50	35	5	5	5
7	Introduction to IT system Lab	ESC	1	2	50	35	5	5	5
8	Engineering Mechanics Lab	ESC	1	2	50	35	5	5	5
9	Engineering Graphics	ESC	2	4	50	35	5	5	5
	Total		**20**	**27**	**650**	**455**	**110**	**42.5**	**42.5**

SEMESTER II (Group-A)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Mathematics -II	BSC	4	4	100	70	20	5	5
2	Fundamentals of Electrical & Electronics Engg.	ESC	4	4	100	70	20	5	5
3	Introduction to IT system	ESC	3	3	100	70	20	5	5
4	Engineering Mechanics	ESC	4	4	100	70	20	5	5
5	Environmental Science	AC	0	2	50	35	10	2.5	2.5
	Practical								
6	Fundamentals of electrical & electronics Engg. Lab	ESC	1	2	50	35	5	5	5
7	Introduction to IT system Lab	ESC	1	2	50	35	5	5	5
8	Engineering Mechanics Lab	ESC	1	2	50	35	5	5	5
9	Engineering Graphics	ESC	2	4	50	35	5	5	5
	Total		**20**	**27**	**650**	**455**	**110**	**42.5**	**42.5**

SEMESTER –II(Group-B)

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Communication Skills in English	HSC	3	3	100	70	20	5	5
2	Mathematics-II	BSC	4	4	100	70	20	5	5
3	Applied Physics	BSC	4	4	100	70	20	5	5
4	Applied Chemistry	BSC	4	4	100	70	20	5	5
	Practical								
5.	Engineering Workshop Practice	ESC	2	4	50	35	5	5	5
6.	Applied Physics Lab	BSC	1	2	50	35	5	5	5
7.	Applied Chemistry Lab	BSC	1	2	50	35	5	5	5
8.	Communication Skills in English Lab	HSC	1	2	50	35	5	5	5
	Total		**20**	**25**	**600**	**420**	**100**	**40**	**40**

SEMESTER-III

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA*	Attendance
1	Strength of Materials	PCC	4	4	100	70	20	5	5
2	Material Science & Engineering	PCC	3	3	100	70	20	5	5
3	Fluid Mechanics & Hydraulic Machinery	PCC	4	4	100	70	20	5	5
4	Manufacturing Technology-I	PCC	3	3	100	70	20	5	5
5	Thermal Engineering-I	PCC	3	3	100	70	20	5	5
	Practical								
6	Strength of Materials Lab	PCC	1	2	50	35	5	5	5
7	Fluid Mechanics & Hydraulic Machinery Lab	PCC	1	2	50	35	5	5	5
8	Manufacturing Technology-I Lab	PCC	1	2	50	35	5	5	5
9	Thermal Engineering- I Lab	PCC	1	2	50	35	5	5	5
10	Summer Internship-I(3-4 Weeks)	PROJ	2	0	50	35	15	0	0
	TOTAL		**23**	**25**	**750**	**525**	**135**	**45**	**45**

SEMESTER-IV

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory/ Practical Exam	CIA *	Attendance
1	Measurements & Metrology	PCC	3	3	100	70	20	5	5
2	Manufacturing Technology-II	PCC	4	4	100	70	20	5	5
3	Thermal Engineering - II	PCC	4	4	100	70	20	5	5
4	Elective-I Tool Engineering Heat Transfer Farm Equipment & Farm Machinery	PEC	3	3	100	70	20	5	5
5	Elective-II Computer Integrated Manufacturing Refrigeration & Air-conditioning Material Handling Systems	PEC	3	3	100	70	20	5	5
6	Essence of Indian Knowledge Tradition	AC	0	2	50	35	10	2.5	2.5
	Practical								
7	Measurements & Metrology Lab	PCC	1	2	50	35	5	5	5
8	Computer Aided Machine Drawing Practice Lab	PCC	1	2	50	35	5	5	5
9	Manufacturing Technology –II Lab	PCC	1	2	50	35	5	5	5
10	Thermal Engineering– II Lab	PCC	1	2	50	35	5	5	5
11	Minor Project	PROJ	2	4	50	35	15	0	0
	TOTAL		**23**	**31**	**800**	**560**	**145**	**47.5**	**47.5**

SEMESTER V

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory / Practical Exam	Mid Term Theory / Practical Exam	CIA*	Attendance
1	Advanced Manufacturing Processes	PCC	3	3	100	70	20	5	5
2	Theory of Machines & Mechanisms	PCC	3	3	100	70	20	5	5
3	Industrial Engineering & Management	PCC	3	3	100	70	20	5	5
4	Elective-III Computer Aided Design and Manufacturing Automobile Engineering Hybrid Vehicles	PEC	3	3	100	70	20	5	5
5	Elective-IV Industrial Robotics & Automation Power Plant Engineering Mechatronics	PEC	3	3	100	70	20	5	5
6	Open Elective-I Renewable Energy Technology Operation Research Internet of Thing	OEC	3	3	100	70	20	5	5
	PRACTICAL								
7	CAD/CAM Lab	PCC	1	2	100	70	20	5	5
8	Theory of Machines & Mechanisms Lab	PCC	1	2	50	35	5	5	5
9	Summer Internship-II(4-6 Weeks)	PROJ	3	0	100	70	30		
10	Major Project-I (Project to be carried over to next semester)	PROJ	1	2	50	35	15		
	TOTAL		**24**	**24**	**900**	**630**	**190**	**40**	**40**

SEMESTER VI

S.No	Name of the Subject	Type of Paper	Credit	Contact Hours Per Week	Total Marks	End Term Theory/ Practical Exam	Mid Term Theory / Practical Exam	CIA*	Attendance
1	Design of Machine Elements	PCC	3	3	100	70	20	5	5
2	Production & Operations Management	PCC	3	3	100	70	20	5	5
3	Entrepreneurship and Start-ups	PROJ	4	4	100	70	20	5	5
4	Open Elective-II Sustainable Development Robotics Artificial Intelligent & Machine Learning	OEC	3	3	100	70	20	5	5
5	Open Elective-III Project Management Product Design Cyber Security Laws, Standards & IPR 3-D Printing	OEC	3	3	100	70	20	5	5
6	Indian Constitution	AC	0	2	50	35	10	2.5	2.5
	PRACTICAL								
7	Seminar	PROJ	1	2	50	35	15	0	0
8	Major Project-II	PROJ	3	0	100	70	30	0	0
	TOTAL		**20**	**20**	**700**	**490**	**155**	**27.5**	**27.5**

Distribution of Credit across 6 semesters:

Sl. No	Type of Paper	No. of Paper	Total Credit
1	Humanities and Social Sciences Courses **(HSC)**	3	7
2	Basic Science courses**(BSC)**	6	18
3	Engineering Science courses **(ESC)**	8	18
4	Professional core courses (**PCC)**	23	53
5	Professional Elective courses**(PEC)**	4	12
6	Open Electives Courses (**OEC)**	3	9
7	Project work, seminar and internship in industry or elsewhere**(PROJ)**	6	12
8	Audit Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]**(AC)**	3	(non-credit)
	Total	56	129

CIA – Continuous Internal Assessment – Based on Projects / Assignment during the semester

Note:

AICTE Activity Points to be earned by students admitted to Diploma program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 3 year Diploma program, is required to earn 75 activity points in addition to the total credits earned for the program. Students entering 3 years Diploma Program through lateral entry are required to earn 50 activity points in addition to the total credits earned for the program.
The activity points earned by the student shall be reflected on the students 6th Semester grade card.
The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled.
Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.
Incase student fail to earn the prescribed activity points, Sixth semester Grade Card shall be issued only after earning the required activity Points.
Students shall be eligible for the award of degree only after the release of the Six Semester grade card.

There are two groups (A & B) in semester 1 & 2. The Group division will be decided by The Dean SoE& IT before commencement of classes*

ARKAJAIN University, Jharkhand
School of Engineering & IT
Department of Engineering
Faculty – Diploma in Mechanical Engineering (DEME)
PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PROGRAM OUTCOMES

After completing this undergraduate program, a learner:

PO.1]. Basic knowledge: An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems

[PO.2]. Discipline knowledge: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.

[PO.3]. Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

[PO.4]. Engineering Tools: Apply appropriate technologies and tools with an understanding of the limitation.

[PO.5]. The engineer and society: Demonstrate knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering practice.

[PO.6]. Environment and sustainability: Understand the impact of the engineering solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development..

[PO.7]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

[PO.8]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse/multidisciplinary teams.

[PO.9]. Communication: An ability to communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.10]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological changes.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. Maintenance selection and use of various equipment and machinery and instruments in mechanical processes.

[PSO.2]. Supervise and manage production process and demonstrate a knowledge of management and business practices, such as risk and change management, and understand their limitations.

Subject: Design of Machine Elements

Code: DIP16122

3Credits | Semester VI

A. Introduction:

- To enable the student to design and draw simple machine components used in small and medium scale industries.
- To understand the basic philosophy and fundamentals of Machine Design.
- To understand the modes of failures of m/c components and decide the design criteria and equations.
- To analyze and evaluate the loads, forces, stresses involved in components and subassemblies and decide the dimensions.
- To develop analytical abilities to give solutions to engineering design problems.

B. Course Outcomes: At the end of the course

[CO 1] Analyze the various modes of failure of machine components under different load patterns.
[CO 2]Design and prepare part and assembly drawings.
[CO 3]Use design data books and different codes of design.
[CO 4] Select standard components with their specifications from manufacturer's catalogue.
[CO 5] Develop drawings on CAD software.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

INTRODUCTION TO DESIGN: Machine Design philosophy and Procedures; General Considerations in Machine Design; Fundamentals: Types of loads, concepts of stress, Strain, Stress – Strain Diagram for Ductile and Brittle Materials, Types of Stresses; Bearing pressure Intensity; Crushing; Bending and Torsion; Principal Stresses; Simple Numericals; Creep strain and Creep Curve; Fatigue; S-N curve; Endurance Limit; Factor of Safety and Factors governing selection of factor of Safety; Stress Concentration: Causes & Remedies; Converting actual load or torque into design load or torque using design factors like velocity factor, factor of safety & service factor; Properties of Engineering materials; Designation of materials as per IS and introduction to International standards & advantages of standardization; Use of design data book; Use of standards in design and preferred numbers series; Theories of Elastic Failures; Principal normal stress theory; Maximum shear stress theory & Maximum distortion energy theory.

DESIGN OF SIMPLE MACHINE PARTS: Cotter Joint; Knuckle Joint; Turnbuckle; Design of Levers: Hand/Foot Lever & Bell Crank Lever; Design of C–Clamp; Off-set links; Overhang Crank; Arm of Pulley.Antifriction Bearings: Classification of Bearings; Sliding contact & Rolling contact; Terminology of Ball bearings: Life Load relationship, Basic static load rating and Basic dynamic load rating, limiting speed; Selection of ball bearings using manufacturer's catalogue.

DESIGN OF SHAFTS, KEYS, COUPLINGS AND SPUR GEARS: Types of Shafts; Shaft materials; Standard Sizes; Design of Shafts (Hollow and Solid) using strength and rigidity criteria; ASME code of design for line shafts supported between bearings with one or two pulleys in between or one overhung pulley; Design of Couplings – Muff Coupling, Protected type Flange Coupling, Bush-pin type flexible coupling; Spur gear design considerations. Lewis equation for static beam strength of spur gear teeth; Power transmission capacity of spur gears in bending.Design of Sunk Keys; Effect of Keyways on strength of shaft;

DESIGN OF POWER SCREWS: Thread Profiles used for power Screws - Relative merits and demerits of each; Torque required to overcome thread friction;Self-locking and overhauling property; Efficiency of power screws; Types of stresses induced; Design of Screw Jack; Toggle Jack. **Design of springs**: Classification and Applications of Springs; Spring terminology; Materials and Specifications; Stresses in springs; Wahl's correction factor; Deflection of springs; Energy stored in springs; Design of Helical, Tension and Compression springs subjected to uniform applied loads like I.C. engine valves, Weighing balance, Railway buffers and Governor springs; Leaf springs: Construction and Application.

DESIGN OF FASTENERS: Stresses in Screwed fasteners; Bolts of Uniform Strength; Design of Bolted Joints subjected to eccentric loading; Design of Parallel and Transverse fillet welds; Axially loaded symmetrical section; Merits and demerits of screwed and welded joints.Ergonomics& Aesthetic consideration in design: Ergonomics of Design: Man–Machine relationship; Design of Equipment for control, environment & safety; Aesthetic considerations regarding shape, size, color & surface finish.

E. TEXT BOOKS

T1.Machine Design – Sadhu Singh, Khanna Book Publishing Co., Delhi (ISBN: 978-9382609-575)
T2.Machine Design Data Book – Sadhu Singh, Revised Edition, Khanna Book Publishing Co., Delhi(ISBN: 978-9382609-513)
T3.Introduction to Machine Design – V.B.Bhandari, Tata Mc- Graw Hill, New Delhi.
T4.Mechanical Engineering Design – Joseph Edward Shigley, Tata Mc- Graw Hill, New Delhi.
T5.Machine design – Pandya & Shah, Dhanpat Rai & Son, New Delhi.

F. REFERENCE BOOKS

R1.Machine design – R.K.Jain, Khanna Publication, New Delhi.
R2.Design Data Book – PSG Coimbtore, PSG Coimbtore.
R3.Hand Book of Properties of Engineering Materials & Design Data for Machine Elements – Abdulla Shariff, Dhanpat Rai & Sons, New Delhi.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Analyze the various modes of failure of machine components under different load patterns.	3	3		2							3	
[CO2]	Design and prepare part and assembly drawings.	2	2	3	2							2	3
[CO3]	Use design data books and different codes of design.	2	2	3	3							3	3
[CO4]	Select standard components with their specifications from manufacturer's catalogue.			3	2	3							3
[CO5]	Develop drawings on CAD software.	3	3		2							2	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Production & Operations Management

Code: DIP16271

3 Credits | Semester VI

A. Introduction:

- One of the most critical areas for success in any business enterprise is how Production and Operations are managed.
- To study the statistics, economics, finance, organizational behaviour and strategy into a consolidated production and operation related decisions.
- To discuss the role of location strategy and the criteria for location decisions.
- To define quality and explain quality management, including TQM and its tools.

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Define operations management and explain its relationship to productivity. And understand tools and techniques.

[CO 2]Describe the importance of forecasting and explain the effective application of the different forecasting approaches and methods.

[CO 3]Explain layout strategy and how operations managers determine facility arrangements and size.

[CO 4] Describe how operations managers achieve a reasonable work environment and set expectations related to employee productivity.

[CO 5] Understand make-or-buy decisions, and the selection and integration of suppliers. And how much to order and when to order.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

PROCESS PLANNING AND PROCESS ENGINEERING: Process Planning: Introduction, Function, Pre-requisites and steps in process planning, Factors affecting process planning, Make or buy decision, plant capacity and machine capacity. Process Engineering: Preliminary Part Print Analysis: Introduction, Establishing the General Characteristics of work piece, determining the principal Process, Functional surfaces of the work piece, Nature of the work to be Performed, Finishing and identifying operations. Dimensional Analysis: Introduction, types of dimensions, measuring the Geometry of form, Baselines, Direction of specific dimensions, Tolerance Analysis: Causes of work piece variation, Terms used in

work piece dimensions, Tolerance stacks.Workpiece Control: Introduction, Equilibrium Theories, Concept of location, Geometric Control, Dimensional control, Mechanical control.

PRODUCTION FORECASTING: Introduction of production forecasting, The strategic role of forecasting in supply chain, Time frame, Demand behavior, Forecasting methods- Qualitative and Quantitative, Forecast accuracy.Scheduling Introduction, Objectives in scheduling, Loading, Sequencing, Monitoring, Advanced Planning and Scheduling Systems, Theory of Constraints, Employee scheduling.

BREAK-EVEN ANALYSIS: Introduction, Break-even analysis charts, breakeven analysis for Process, plant and equipment selection. Aggregate Operations Planning**:** Aggregate production planning, Adjusting capacity to meet the demand, Demand management, Hierarchical and collaborative planning, Aggregate planning for services.

ASSEMBLY LINE BALANCING: Assembly lines, Assembly line balancing, Splitting tasks, Flexible and U-shaped line layouts, mixed model line balancing, Current thoughts on assembly lines, Computerized assembly line balancing.

MATERIAL MANAGEMENT: Introduction, Importance and objectives, Purchasing and Stores:policies and procedures,Vendor development, selection, analysis and rating.

E. TEXT BOOKS

T1.Production and Operations Management – K.Aswathappa, K.Shridhara Bhat, Himalaya Publishing House, 2014.
T2.Production and Operations Management – Shailendra Kale, McGraw Hill Educations(India) Private Limited,2013.
T3.Production and Operations Management – R.Paneerselvam, PHI Learning Private Limited, 2013.

F. REFERENCE BOOKS

R1.Operations Management – Joseph Monk, TMH Publishers, New Delhi, 2004.
R2.Modern Production /Operations Management – Buffa Elwood S, John Wiley Publishers, Singapore,2002.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Analyze the various modes of failure of machine components under different load patterns.	3	3		2							3	
[CO2]	Design and prepare part and assembly drawings.	2	2	3	2							2	3
[CO3]	Use design data books and different codes of design.	2	2	3	3							3	3
[CO4]	Select standard components with their specifications from manufacturer's catalogue.		2	3	2	3							3
[CO5]	Develop drawings on CAD software.	3	3		2							3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject:Entrepreneurship and Start-Ups

Code: DIP16265

4 Credits | Semester VI

A. Introduction:

- Acquiring Entrepreneurial spirit and resourcefulness.
- Familiarization with various uses of human resource for earning dignified means of living.
- Understanding the concept and process of entrepreneurship - its contribution and role in the
- Growth and development of individual and the nation.
- Acquiring entrepreneurial quality, competency, and motivation.
- Learning the process and skills of creation and management of entrepreneurial venture

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Understanding the dynamic role of entrepreneurship and small businesses.
[CO2]Organizing and Managing a Small Business
[CO3]Financial Planning and Control
[CO4] Forms of Ownership for Small Business
[CO5] Strategic Marketing Planning

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

INTRODUCTION TO ENTREPRENEURSHIP AND START – UPS: Definitions, Traits of an entrepreneur, Entrepreneurship, Motivation.Types of Business Structures, Similarities/differences between entrepreneurs and managers.

BUSINESS IDEAS AND THEIR IMPLEMENTATION: Discovering ideas and visualizing the business Activity map Business Plan

IDEA TO START-UP: Market Analysis – Identifying the target market, Competition evaluation and Strategy Development, Marketing and accounting, Risk analysis.

MANAGEMENT: Company's Organization Structure,Recruitment and management of talent.Financial organization and management

FINANCING AND PROTECTION OF IDEAS: Financing methods available for start-ups in India Communication of Ideas to potential investors – Investor Pitch Patenting and Licenses,Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy.

E. TEXT BOOKS

T1.The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company Steve Blank and Bob Dorf K & S Ranch ISBN – 978-09849993922.
T2.The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses Eric Ries Penguin UK ISBN – 978-0670921607

F. REFERENCE BOOKS

R1.Demand: Creating What People Love Before They Know They Want It Adrian J. Slywotzky with Karl Weber Headline Book Publishing ISBN – 978-0755388974
R2.The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business Clayton M. Christensen Harvard business ISBN: 978-142219602

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	] Understanding the dynamic role of entrepreneurship and small businesses.	3	3		2							3	
[CO2]	Organizing and Managing a Small Business	2	2	3	2							2	3
[CO3]	Financial Planning and Control	2	2	3	3							3	3
[CO4]	Forms of Ownership for Small Business		2	3	2	3							3
[CO5]	Strategic Marketing Planning	3	2	2	2							3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Sustainable Development

Code:DIP16267

3 Credits | Semester VI

A. Introduction:

- To impart knowledge on the principles for balancing social, economic and environmental dimensions of development and the associated international and national frameworks

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Describe the national and global environmental, economic and social issues and the principles of different sustainable development frameworks
[CO2]Apply the sustainable development principles during the planning of developmental activities
[CO3]Understand the ethics and rights of engineers.
[CO4]Consideration of Environmental and Human health policies

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

INTRODUCTION: Status of environment – Environmental, Social and Economic issues,Need for sustainability – Nine ways to achieve sustainability.Population, resources, development and environment

CHALLENGES OF SUSTAINABLE DEVELOPMENT AND GLOBLE: Environmental issueConcept of sustainability – Factors governing sustainable development – Linkages among sustainable development- Environment and poverty – Determinants of sustainable development – Case studies on sustainable development – Population, income and urbanization – Health care – Food, fisheries and agriculture – Materials and energy flows.

SUSTAINABLE DEVELOPMENT INDICATORS: Need for indicators – Statistical procedures – Aggregating indicators.Use of principal component analysis – Three environmental quality indices

HUMAN RIGHTS AND GENDER EQUALITY:Introduction to the challenges around equality, equity and fairness to all.Drivers of Inequality, Sustainable Cities.Education and Sustainable Development Introduction to a life-cycle approach, and the role of education in sustainable development

ENVIRONMENTAL AND HUMAN HEALTH: Exploration of how primary health care systems are linked to poverty, and the interaction between the environment and human health.Exploration of how primary health care systems are linked to poverty, and the interaction between the environment and human health.

E. TEXT BOOKS

T1.Sayer, J. and Campbell, B., "The Science of Sustainable Development: Local Livelihoods and the Global Environment" (Biological Conservation, Restoration &Sustainability), Cambridge University Press, London, 2003.

T2.Kirkby, J., O'Keefe P. and Timberlake, "Sustainable Development", Earth scan Publication, London, 1993.

F. REFERENCE BOOKS

R1.Peter P. Rogers, Kazi F. Jalal, John A. Boyd, "An introduction to sustainable development", Glen Educational Foundation, 2008.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Describe the national and global environmental, economic and social issues and the principles of different sustainable development frameworks	3	3		2							3	
[CO2]	Apply the sustainable development principles during the planning of developmental activities	2	2		2							2	1
[CO3]	Understand the ethics and rights of engineers.		2					3		2		3	
[CO4]	Consideration of Environmental and Human health policies					2	3	3					

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Robotics

Code: DIP16273

3 Credits | Semester VI

A. Introduction:

- System design and control strategies for aerial robots physically interacting with the human world.
- The design of the entire system addressing the interaction with the environment represents one of the main contributions of this project to the field of aerial robotics and control systems design
- New contribution to human-robot interaction and communication.
- One of the objectives is to develop an advanced human-robot interface for endowing the system with advanced action capabilities.

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] You have basic knowledge in programming, electronics, digital technology and mathematics.
[CO 2]you have knowledge of how computers, embedded systems and robots work and how they can understand and adapt to the world.
[CO 3]You can analyze and model systems that contain both software, hardware and mechanics
[CO 4] knowledge about electronics and sensors that form the basis for machine launching
[CO 5] knowledge of mathematics required for electronics, programming and robotics

C. Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

INTRODUCTION TO ROBOTICS: Evolution of Robots and Robotics, Laws of Robotics, What is and What is not a Robot, Progressive.Characteristics, Design and Control Issues,Manipulation and Control, Sensors and Vision, Programming Robots, The Future Prospects, Notations.

COORDINATE FRAMES: Mapping and TransformsCoordinate Frames, Description of Objects in Space, Transformation of Vectors. Inverting a Homogeneous Transform, Fundamental Rotation Matrices

SYMBOLIC MODELING OF ROBOTS: Direct Kinematic Model Mechanical Structure and Notations, Description of Links and Joints, Kinematic Modeling of the Manipulator, Denavit – Hartenberg Notation, Kinematic Relationship between Adjacent Links, Manipulator Transormation Matrix. Introduction to Inverse Kinematic model

ROBOTIC SENSORS AND VISION:The Meaning of Sensing, Sensors in Robotics, Kinds of Sensors used in Robotics, Robotic vision, Industrial Applications of Vision-Controlled Robotic Systems, Process of Imaging, Architecture of Robotic Vision Systems, Image Acquisition, Description of Other components of Vision System, Image Representation, Image Processing.

ROBOT APPLICATIONS: Industrial Applications, Material Handling, Processing Applications, Assembly Applications, Inspection Application, Principles for Robot Application and Application Planning, Justification of Robots, Robot Safety, Non-Industrial Applications, Robotic application for sustainable Development.

E. TEXT BOOKS

T1.Robotics Control Sensing, Vision and Intelligence – K.S.Fu, R.C.Gonzalex, C.S.G.Lee- McGrew hil Book co.

T2.Kinematics and Synthesis of linkages – Hartenberg and Denavit – McGrew Hill Book Co

F. REFERENCE BOOKS

R1.Kinematics and Linkage Design – A.S. Hall – Prentice Hall

R2.Kinematics and Dynamics of Machinary – J.Hirchhorn – McGrew HillBook Company

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	You have basic knowledge in programming	3	3		2							3	
[CO2]	You have knowledge of how computers, embedded systems and robots work and how they can understand and adapt to the world.	2	2	3	2							2	3
[CO3]	You can analyze and model systems that contain both software, hardware and mechanics	3	2	3	3							3	3
[CO4]	knowledge about electronics and sensors that form the basis for machine launching		2	3	2	3							3
[CO5]	knowledge of mathematics required for electronics, programming and robotics	3	3		2							3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Artificial Intelligent & Machine Learning

Code:DIP15215

3 Credits | Semester VI

A. Introduction:

- Have a thorough understanding of classical and modern AI applications. Be able to implement a wide range of AI concepts using Prolog. Understand non-classical AI approaches such as genetic algorithms and neural networks. Be able to assess the potential of AI in research and real-world environments

B. Course Outcomes: At the end of the course, students will be able to

[CO1] Identify problems that are amenable to solution by AI methods.
[CO2]Design and carry out an empirical evaluation of different algorithms on a problem formalization, and state the conclusions that the evaluation supports.
[CO3]Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
[CO4] able to design and implement various machine learning algorithms in a range of real-world applications.
[CO5] Machine Learning algorithms and the paradigms of supervised and un-supervised learning.

C. Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

INTRODUCTION: History and foundations of AI, Problem solving: Uninformed and informed Search; Constraint Satisfaction Problems and Constrained Optimization problems (complete and incomplete techniques)

ADVERSARIAL SEARCH: Two players games, games with uncertainty; Decision support systems and technologies, Knowledge representation, Reasoning, Expert systems Contents (2/2), Planning(basics).

MACHINE LEARNING BASICS: Decision trees, Ensemble learning, Reinforcement learning, Evolutionary computation,Neural networks, Problems, data, and tools; Visualization;

LINEAR REGRESSION :SSE; gradient descent; closed form; normal equations; features, Over fitting and complexity;training, validation, test data, and introduction to Matlab.

CLASSIFICATION PROBLEMS: Decision boundaries; Probability and classification, Bayes optimal decisions,Naive Bayes and Gaussian class-conditional distribution.

E.TEXT BOOKS

T1.Russell, Norvig, Artificial intelligence: A modern approach, 2nd edition. Pearson/Prentice Hall.

F. REFERENCE BOOKS

R1.Ethem Alpaydin, Introduction to Machine Learning, Second Edition,

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G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Identify problems that are amenable to solution by AI methods.	3	3		2							3	
[CO2]	Design and carry out an empirical evaluation of different algorithms on a problem formalization, and state the conclusions that the evaluation supports.	2	2	3	2							2	3
[CO3]	Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.	2	2	3	3							3	3
[CO4]	Able to design and implement various machine learning algorithms in a range of real-world applications.		2	3	2	3							3
[CO5]	Machine Learning algorithms and the paradigms of supervised and un-supervised learning.	3	3		2							3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Project Management

Code:DIP16257

3 Credits | Semester VI

A. Introduction:

- To develop the idea of project plan, from defining and confirming the project goals and objectives, identifying tasks and how goals will be achieved.
- To develop an understanding of key project management skills and strategies.

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Understand the importance of projects and its phases.
[CO 2]Analyze projects from marketing, operational and financial perspectives.
[CO 3]Evaluate projects based on discount and non-discount methods.
[CO 4] Develop network diagrams for planning and execution of a given project.
[CO 4]Apply crashing procedures for time and cost optimization.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

CONCEPT OF A PROJECT: Classification of projects- importance of project management- The project life cycle- establishing project priorities (scope-cost-time)project priority matrix- work break down structure.project priority matrix- work break down structure.

CAPITAL BUDGETING PROCESS: Planning- Analysis-Selection-Financing-Implementation-Review. Generation and screening of project ideas- market and demand analysis- Demand forecasting Techniques Market planning and marketing research process- Technical analysis.

FINANCIAL ESTIMATES AND PROJECTIONS: Cost of projects-means of financing-estimates of sales and production-cost of production-working capital requirement and its financing-profitability projected cash flow statement and balance sheet. Break even analysis..

BASIC TECHNIQUES IN CAPITAL BUDGETING: Non discounting and discounting methods-payback period- Accounting rate of return-net present value-Benefit cost ratio-internal rate of return. Project risk. Social cost benefit analysis and economic rate of return. Non-financial justification of projects**.**

PROJECT ADMINISTRATION: progress payments, expenditure planning, project scheduling and network planning, use of Critical Path Method (CPM), schedule of payments and physical progress, time-cost trade off. Concepts and uses of PERT cost as a function of time, Project Evaluation and Review Techniques/cost mechanisms Determination of least cost duration. Post project evaluation. Introduction to various Project management software

E. TEXT BOOKS

F. REFERENCE BOOKS

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	**]** Understand the importance of projects and its phases.	**3**	**3**		**2**							**3**	
[CO2]	Analyze projects from marketing, operational and financial perspectives.	**2**	**2**		**2**							**2**	**1**
[CO3]	Evaluate projects based on discount and non-discount methods.		**2**					**3**		**2**		**3**	
[CO4]	Develop network diagrams for planning and execution of a given project.					**2**	**3**	**3**					
[CO5]	**A**pply crashing procedures for time and cost optimization.		**2**		**3**								

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Product Design

Code:DIP16270

3 Credits | Semester VI

A. Introduction:

- To acquire the basic concepts of product design and development process
- To understand the engineering and scientific process in executing a design from concept to finished product
- To study the key reasons for design or redesign.

B. Course Outcomes: At the end of the course, students will be able to

[CO 1] Understand the basic concepts of product design and development process.
[CO 2]Illustrate the methods to define the customer needs.
[CO 3]Describe an engineering design and development process.
[CO 4] Understand the intuitive and advanced methods used to develop and evaluate a concept.
[CO 5] Apply modeling and embodiment principles in product design and development process.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

DEFINITION OF A PRODUCT: Types of product; Levels of product; Product-market mix; New product development (NPD) process; Idea generation methods; Creativity; Creative attitude; Creative design process; Morphological analysis; Analysis of interconnected decision areas; Brain storming.

PRODUCT LIFE CYCLE: The challenges of Product development; Product analysis; Product characteristics; Economic considerations; Production and Marketing aspects; Characteristics of successful Product development; Phases of a generic product development process; Customer need identification; Product development practices and industry-product strategies.

PRODUCT DESIGN: Design by evolution; Design by innovation; Design by imitation; Factors affecting product design; Standards of performance and environmental factors; Decision making and iteration; Morphology of design (different phases); Role of aesthetics in design.

INTRODUCTION TO OPTIMIZATION IN DESIGN: Economic factors in design; Design for safety and reliability; Role of computers in design; Modeling and Simulation; The role of models in engineering design; Six sigma and design for six sigma; Introduction to optimization in design; Economic factors and

financial feasibility in design; Design for manufacturing; Rapid Prototyping (RP); Application of RP in product design; Product Development versus Design

DESIGN OF SIMPLE PRODUCTS: Design of simple products dealing with various aspects of product development; Design starting from need till the manufacture of the product,

E. TEXT BOOKS

T1.Product Design and Development, Karl T. Ulrich and Steven D. Eppinger, Tata McGraw–Hilledition.
T2.Engineering Design –George E. Dieter.
T3.An Introduction to Engineering Design methods Vijay Gupta.
T4.Merie Crawford : New Product management, McGraw-Hill Irwin.
T5.Chitale A K and Gupta R C, "Product Design and Manufacturing", Prentice Hall of India, 2005.

F. REFERENCE BOOKS

R1.Kevin Otto and Kristin Wood, Product Design, Techniques in Reverse Engineering and New
R2.Product Development, Pearson education.

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Understand the basic concepts of product design and development process.	3	3		2							3	
[CO2]	Illustrate the methods to define the customer needs.	2	3		2							2	1
[CO3]	Describe an engineering design and development process.		2					3		2		3	
[CO4]	Understand the intuitive and advanced methods used to develop and evaluate a concept.					2	3	3					
[CO5]	Apply modeling and embodiment principles in product design and development process.	2	2			2			2				2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Cyber Security Laws, Standards & IPR

Code:DIP16262

3 Credits | Semester VI

A. **Introduction:**

- Cyber Security is to achieve these three elements (Confidentiality, Integrity and Availability) and also knows as CIA Triad. For any organization, it's essential to protect its data, information using security tools.
- Implement Cyber Security Best Practices and Risk Management

B. **Course Outcomes: At the end of the course, students will be able to**

[CO 1] Conduct a cyber security risk assessment
[CO 2]Measure the performance and troubleshoot cyber security systems.
[CO 3]Implement cyber security solutions.
[CO 4] Students able to use cyber security, information assurance, and cyber/computer forensics software/tools.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

BASIC OF COMPUTER AND CYBER SECURITY: History of Computers, Areas of Application Computers and its components, Application Software and System Software
Introduction to Operating System. Basics of Networks and internet, Types of Network, Definition of Cyber Security, Search Engines, E –mails and WWW; Internetworking Devices, Internet Service provider, IP Address, Working of Email system, Domain Name System, Blogs, Peer to peer sharing, Computer & Cyber Security:(a) Types of Attacks,(b) Network Security(c) Overview of Security threats,(d) Hacking Techniques,(e) Password cracking(f) Insecure Network connections,(g) Malicious code(h) Concept of Fire wall Security

INFORMATION TECHNOLOGY LAW(CYBER LAW): Evolution of the IT Act, Genesis and Necessity. Salient features of the IT Act, 2000, various authorities under IT Act and their powers. ; Penalties & Offences, amendments. Different kinds of cyber law in Indian history.

CYBER SPACE JURISDICTION: (a) Jurisdiction issues under IT Act, 2000.(b) Traditional principals of Jurisdiction(c) Extra-terrestrial Jurisdiction(d) Case Laws on Cyber Space Jurisdiction

CYBER CRIME AND INVESTIGATION PROCEDURES: Cyber Forensic and Computer Crimes and types. Crimes targeting Computers:Definition of Cyber Crime & Computer related Crimes, Classification & Differentiation between traditional crime and cybercrimes. (a) Data Theft (b) Hacking (c) Spreading Virus & Worms (d) Phishing (e) Cyber Stalking / Bullying (f) Identity Theft & Impersonation (g) Credit card & Online Banking Frauds, Reasons for Cyber Crimes. Cyber Criminal Mode and Manner of Committing Cyber Crime Prevention of Cyber Crimes & Frauds Critical analysis & loop holes of The IT Act,2000Cyber Crimes: Freedom of speech in cyber space & human right issue Investigation of Cyber Crimes ,Investigation of malicious applications, Agencies for investigation in India, their powers and their constitution as per Indian Laws

PRACTICAL TRAINING / PROJECT WORK: The project report submitted by the student will be evaluated jointly by the internal and external examiners during the practical examination. The distribution of marks will be as follows: (a) Dissertation : 40 Marks (b) Report of field work &Presentation: 40 Marks (c) Viva – Voice : 15 Marks (d) Attendance : 05 Marks

E. TEXT BOOKS

T1.Cyber Law & Cyber Crimes by AdvocatPrashant Mali; Snow White publications, Mumbai
T2.Cyber Law in India by Farooq Ahmad; Pioneer Books
T3.Information Technology Law and Practice by Vakul Sharma; Universal Law Publishing Co. Pvt. Ltd.
T4The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
T5.Guide to Cyber and E – Commerce Laws by P.M. Bukshi and R.K. Suri; Bharat Law House, New Delhi
T6.Guide to Cyber Laws by Rodney D. Ryder; Wadhwa and Company, Nagpur
T7.The Information Technology Act, 2000; Bare Act – Professional Book Publishers, New Delhi

F. REFERENCE BOOKS

R1.Computer Forensics: Principals and Practices by Linda Volonino, Reynaldo Anzaldua and Jana Gdwin; Pearson Prentice – Hall 2007
R2First Responder's Guide to Computer Forensics by Richard Nolan rt al; Carnegi Mellon, 2005.
R3.Digital Evidence and Computer Crime, 2nd Ed. By Eoghan Casey; Academic Press, 2004.
R4.The Regulation of Cyberspace by Andrew Murray, 2006; Rutledge – Cavendish.
R5.Scene of the Cybercrime: Computer Forensics Handbook by Syngress.
T13.Security and Incident Response by Keith J. Jones, Richard Bejtloich and Curtis W.Rose

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Conduct a cyber security risk assessment	3	3		2							3	
[CO2]	Measure the performance and troubleshoot cyber security systems.	2	2		2							2	1
[CO3]	Implement cyber security solutions.		2					3		2		3	
[CO4]	Students able to use cyber security, information assurance, and cyber/computer forensics software/tools.					2	3	3					

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: 3-D Printing

Code:DIP16259

3Credits | Semester VI

A. Introduction:

- Learn Design Process Students learn how to visualize conceptual objects and make them a reality using Tinker cad and 3D printing software.
- Replicate Designs Students replicate predetermined designs to familiarize themselves with software. Eventually students use their creativity to modify and improve upon these designs.
- Create New Prototypes Students demonstrate proficiency with replicating and modifying designs, then they move on to create completely new objects of their own and bring them into the world through 3D printing

B. **Course Outcomes:** At the end of the course, students will be able to

[CO 1] Students able to makes 3D printing special, and when to use 3D printing vs. alternative options.
[CO 2]Students able to understand familiarize themselves with the 3D printing process and how it works
[CO 3]Students learn how to visualize and plan projects before getting started, so they can be more efficient
[CO 4] Students spend several days familiarizing themselves with several software programs and combining them to accomplish tasks
[CO 5]Students put all their knowledge together to design and 3D print prototypes for design challenges Students design and print whatever object they would like to take home

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS

INTRODUCTORY TOPICS: Day 1 Introductory Topics Students learn class rules and objectives, and discuss why this course is relevant. Pros and Cons of 3D Printing Students discuss when 3D printing should be used. Fairfax Collegiate · Have Fun and Learn! · For Rising Grades 3 to 9 3D Printing Background Students learn about how 3D printing works and general background about the technology. Students are also introduced to the design challenges they will work on throughout the course. Exercises with MakerBot Print Students use exercises with MakerBot Print to familiarize themselves with the program and its ability to export files to the 3D printer. Thing verse Diorama Students import files from

Thing verse and make a diorama-esque scene, with an emphasis on creativity in design.Day 2Tinker cad Lessons Students use lessons on Tinker cad to familiarize themselves with 3D design.

TINKERCAD LESSONS :Day 3 Tinkercad Lessons Students use lessons on Tinkercad to familiarize themselves with 3D design. Rocket Ship Design Students design and print their own Rocket Ship, Day 4 Tinkercad Projects Students work on Tinkercad Projects. These are more advanced than the Tinkercad Lessons. Avenger Superheroes Students design and print a superhero,

TINKERCAD PROJECTS: Day 5 Tinker cad Projects Students work on Tinkercad Projects. These are more advanced than the Tinker cad Lessons. Prototyping an Invention Students gain free reign to create whatever they please with no constraints.Day 6Scanning Objects Students scan and modify an object of their choosing.

DESIGN CHALLENGE: Day 7Bridge Building Competition Students design, print, and test their own bridges. **Day 8** Design Challenge Fairfax Collegiate · Have Fun and Learn! · For Rising Grades 3 to 9 Students work in groups to design, print, test, and iterate a solution to their design challenged picked out on the first day.

PROBLEM SOLVING WITH 3D PRINTING: Day 9Problem Solving with 3D Printing Students brainstorm and design solutions to household problems using 3D Design and 3D Printing. Prototyping an Invention Students gain free reign to create whatever they please with no constraints.Day 10Prototyping an Invention Students gain free reign to create whatever they please with no constraints. Film Students watch a documentary about 3D printing while final projects print

E. TEXT BOOKS

F. REFERENCE BOOK

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
[CO1]	Students able to makes 3D printing special, and when to use 3D printing vs. alternative options.	3	3		2							3	
[CO2]	Students able to understand familiarize themselves with the 3D printing process and how it works	2	2		2							2	1
[CO3]	Students learn how to visualize and plan projects before getting started, so they can be more efficient		2					3		2		3	
[CO4]	Students spend several days familiarizing themselves with several software programs and combining them to accomplish tasks					2	3	3					
[CO5]	Students put all their knowledge together to design and 3D print prototypes for design challenges Students design and print whatever object they would like to take home		3		2						2	3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Indian Constitution

Code: DIP16266

0 Credits | Semester VI

A. INTRODUCTION:

- The objective of the Constitution of India is to establish a society where there is Justice in social, economic and political. Liberty - thought, expression, faith, belief and worship.

B. COURSE OUTCOMES: By the end of this course, students will be able to:

[CO1] Recall historical background of the Indian constitution.
[CO2] Observe importance for building democratic India, the structure of Indian government, the structure of state government, the local Administration.
[CO3] Develop the knowledge on directive principle of state policy, the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.
[CO4] Analyze the History, features of Indian constitution, the role of Governor and Chief Minister,of state election commission, decentralization of power between central, state and local self-Government.
[CO5] Assess Preamble, Fundamental Rights and Duties,Zilla Panchayat, block level organization, various commissions of viz SC/ST/OBC and women
[CO6] Create ideological framework relied upon by the framers of the Constitution of India, the system of government and role of judiciary by discussing and analyzing the rights and duties specified under the Constitution of India.

C. ASSESSMENT PLAN:

Criteria	**Description**	**Maximum Marks**
Continuous Internal Assessment (CIA)	Internal Examination	20
	Attendance	5
	Assignment	5
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

D. SYLLABUS:

THE CONSTITUTION – INTRODUCTION:

The History of the Making of the Indian Constitution, Preamble and the Basic Structure, and its interpretation. Fundamental Rights and Duties and their interpretation , State Policy Principles

UNION GOVERNMENT:
Structure of the Indian Union, President – Role and Power, Prime Minister and Council of Ministers, Lok Sabha and Rajya Sabha

STATE GOVERNMENT:

Governor – Role and Power, Chief Minister and Council of Ministers, State Secretariat..

.**LOCAL, DISTRICT& ZILA ADMINISTRATION:**
Local Administration, District Administration , Municipal Corporation , Zila Panchayat.

ELECTION COMMISSION:

Election Commission Role and Functioning, Chief Election Commissioner , State Election Commission.

E. TEXT BOOKS

T1. 'Indian Polity' by Laxmikanth
T2. 'Indian Administration' by SubhashKashyap
T3. 'Indian Constitution' by D.D. Basu
T4. 'Indian Administration' by Avasti and Avasti

F. REFERENCE BOOKS

R1. Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008
R2. The Constitution of India B.L. FadiaSahityaBhawan; New edition (2017)

R3. Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Third 2018 edition

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
[CO1]	Recall historical background of the Indian constitution.					3	2	2					
[CO2]	Observe importance for building democratic India, the structure of Indian government, the structure of state government, the local Administration.					3	1	2					
[CO3]	Develop the knowledge on directive principle of state policy, the knowledge in strengthening of					3		2					
[CO4]	Analyze the History, features of Indian constitution, the role of Governor and Chief Minister, of government.					3		2		2			
[CO5]	Assess Preamble, Fundamental Rights and Duties ,Zilla Panchayat, block level organization,					3	2	2		2			
[CO6]	Create ideological framework relied upon by the framers of the Constitution of India, the system of government and role of judiciary by discussing and analyzing the rights and duties specified under the Constitution of India.					2		3					

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Subject: Seminar

Code:DIP16274

1 Credits | Semester VI

A. Introduction:

- The students with consultation with faculty adviser shall arrive at topic of seminar based on exhaustive literature review, current civil engineering scenario, latest techniques or materials etc.
- The students shall review available information and compile the information.
- The students shall prepare technical report.
- The students shall present their seminar to the review committee.
- The seminar topic shall be chosen during the 2nd week of the semester.
- The review and organizing the seminar shall be completed during 6th week.
- The seminar report shall be submitted during 10th week.
- The presentation will be held during 12th week.
- The award of marks is based on the following criteria
    - Selection of Topic for the seminar and its relevance -10%
    - The quality of Seminar Report- 40%
    - Presentation skills and depth of knowledge - 30%
    - Viva and discussion - 20%

B. Course Outcomes:

The students will be able to:

[CO.1]. Appraise the current engineering research/ techniques / developments /interdisciplinary areas.
[CO.1]. Formulate seminar topic by utilizing technical resources/ Journals/ web sources.
[CO.1]. Carry out detailed review of available literature.
[CO.1]. Compose technical report.
[CO.1]. Demonstrate command of voice modulation, voice projection, and pacing duringpresentation.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	15
	Attendance	
	Assignment	
End Semester Examination(ESE)	End Semester Examination	35
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Subject:Major Project-II

Code: DIP16267

3 Credits | Semester VI

A. Introduction: The objective of this course is to prepare students to use applications of the theory and practical learned during the course. It will also help students to develop an industry or research oriented project. This course helps students how to carry out project/studies in the field of interest of the student or as given by the industry.

B .Assessment Plan:

Criteria	Description	Maximum Marks
Continuous Internal Assessment (CIA)	Internal Examination	30
End Semester Examination(ESE)	End Semester Examination	70
Total		100
Attendance	Completion of Internship during the Summer vacation	

GUIDELINES FOR INTERNSHIP

Major Project-II should be based on real/ live problems of the Industry/Govt./NGO/ MSME/Rural Sector or an innovative idea having the potential of a Startup