MATHEMATICS – Third Semester B. Tech

(For all branches except Computer Science and Information Technology)

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MAT201	PARTIAL DIFFERENTIAL EQUATIONS AND COMPLEX ANALYSIS	BASIC SCIENCE COURSE	3	1	0	4

Preamble: This course introduces basic ideas of partial differential equations which are widely used in the modelling and analysis of a wide range of physical phenomena and has got application across all branches of engineering. To understand the basic theory of functions of a complex variable, residue integration and conformal transformation.

Prerequisite: A basic course in partial differentiation and complex numbers**.**

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the concept and the solution of partial differential equation.
CO 2	Analyse and solve one dimensional wave equation and heat equation.
CO 3	Understand complex functions, its continuity differentiability with the use of Cauchy-Riemann equations.
CO 4	Evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula, understand the series expansion of analytic function
CO 5	Understand the series expansion of complex function about a singularity and Apply residue theorem to compute several kinds of real integrals.

Mapping of course outcomes with program outcomes

PO's	Broad area
PO 1	Engineering Knowledge
PO 2	Problem Analysis
PO 3	Design/Development of solutions
PO 4	Conduct investigations of complex problems
PO 5	Modern tool usage
PO 6	The Engineer and Society
PO 7	Environment and Sustainability
PO 8	Ethics
PO 9	Individual and team work

PO 10	Communication
PO 11	Project Management and Finance
PO 12	Life long learning

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	1				2		2
CO 2	3	3	3	3	2	1				2		2
CO 3	3	3	3	3	2	1				2		2
CO 4	3	3	3	3	2	1				2		2
CO 5	3	3	3	3	2	1				2		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests(%)		End Semester Examination(%)
	1	2	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate	10	10	10
Create			

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions.

Course Outcome 1 (CO1):

1. Form the partial differential equation given $z = xf(x) + ye^2$
2. What is the difference between complete integral and singular integral of a partial differential equation
3. Solve $3z = xp + yq$
4. Solve $(p^2 + q^2)y = qz$
5. Solve $u_x - 2u_t = u$ by the method of separation of variables

Course Outcome 2 (CO2):

1. Write any three assumptions in deriving one dimensional wave equations
2. Derive one Dimensional heat equation
3. Obtain a general solution for the one dimensional heat equation $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial t^2}$
4. A tightly stretched flexible string has it's ends fixed at $x = 0$and $x = l$. At $t = 0$, the string is given a shape defined by $f(x) = \mu x(l - x)$ where μ is a constant
5. Find the temperature $u(x, t)$ in a bar which is perfectly insulated laterally whose ends are kept at $0°C$ and whose initial temperature (in degree Celsius) is $f(x) = x(10 - x)$ given that it's length is 10 cm and specific heat is 0.056cal/gram deg

Course Outcome 3(CO3):

1. Separate the real and imaginary parts of $f(z) = \frac{1}{1+z}$
2. Check whether the function $f(z) = \frac{Re(z^2)}{|z|}$ is continuous at $z = 0$ given $f(0) = 0$
3. Determine a and b so that function $u = e^{-\pi x} cosay$ is harmonic. Find it's harmonic conjugate.
4. Find the fixed points of $w = \frac{i}{2z-1}$
5. Find the image of $|z| \leq \frac{1}{2}$, $-\frac{\pi}{8} < argz < \frac{\pi}{8}$under $w = z^2$

Course Outcome 4(CO4):

1. Find the value of $\int_C exp(z^2)dz$ where C is $|z| = 1$
2. Integrate the function $\int_C \frac{sinz}{z+4iz} dz$ where C is $|z - 4 - 2i| = 6.5$
3. Evaluate $\int_C \frac{e^z}{\left(z-\frac{\pi}{4}\right)^3} dz$ where C is $|z| = 1$
4. Find the Maclaurin series expansion of $f(z) = \frac{i}{1-z}$ and state the region of convergence.
5. Find the image of $|z| = 2$ under the mapping $w = z + \frac{1}{z}$

Course Outcome 5 (CO5):

1. Determine the singularity of $exp\left(\frac{1}{z}\right)$
2. Find the Laurent series of $\frac{1}{z^2(z-i)}$ about $z = i$
3. Find the residues of $f(z) = \frac{50z}{z^3 + 2z^2 - 7z + 4}$
4. Evaluate $\int_C tan2\pi z \, dz$ where C is $|z - 0.2| = 0.2$
5. Evaluate $\int_0^{2\pi} \frac{d\theta}{\sqrt{2} - cos\,\theta}$

Syllabus

Module 1 (Partial Differential Equations) (8 hours)

(Text 1-Relevant portions of sections 17.1, 17.2, 17.3, 17.4, 17.5, 17.7, 18.1, 18.2)

Partial differential equations, Formation of partial differential equations –elimination of arbitrary constants-elimination of arbitrary functions, Solutions of a partial differential equations, Equations solvable by direct integration, Linear equations of the first order-Lagrange's linear equation, Non-linear equations of the first order -Charpit's method, Solution of equation by method of separation of variables.

Module 2 (Applications of Partial Differential Equations) (10 hours)

(Text 1-Relevant portions of sections 18.3,18.4, 18.5)

One dimensional wave equation- vibrations of a stretched string, derivation, solution of the wave equation using method of separation of variables, D'Alembert's solution of the wave equation, One dimensional heat equation, derivation, solution of the heat equation

Module 3 (Complex Variable – Differentiation) (9 hours)

(Text 2: Relevant portions of sections13.3, 13.4, 17.1, 17.2 , 17.4)

Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations, harmonic functions, finding harmonic conjugate, Conformal mappings- mappings $w = z^2,, w = e^z,$. Linear fractional transformation $w = \frac{1}{z}$, fixed points, Transformation $w = sinz$

(From sections 17.1, 17.2 and 17.4 only mappings $w = z^2,, w = e^z, w = \frac{1}{z}$, $w = sinz$ and problems based on these transformation need to be discussed)

Module 4 (Complex Variable – Integration) (9 hours)

(Text 2- Relevant topics from sections14.1, 14.2, 14.3, 14.4,15.4**)**

Complex integration, Line integrals in the complex plane, Basic properties, First evaluation method-indefinite integration and substitution of limit, second evaluation method-use of a representation of a path, Contour integrals, Cauchy integral theorem (without proof) on simply connected domain,Cauchy integral theorem (without proof) on multiply connected domain Cauchy Integral formula (without proof), Cauchy Integral formula for derivatives of an analytic function, Taylor's series and Maclaurin series.,

Module 5 (Complex Variable – Residue Integration) (**9 hours**)

(Text 2- Relevant topics from sections16.1, 16.2, 16.3, 16.4 **)**

Laurent's series(without proof), zeros of analytic functions, singularities, poles, removable singularities, essential singularities, Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral using residue theorem, Residue integration of real integrals – integrals of rational functions of $cos\theta$ and $sin\theta$, integrals of improper integrals of the form

$\int_{-\infty}^{\infty} f(x)\,dx$ with no poles on the real axis. ($\int_{A}^{B} f(x)\,dx$ whose integrand become infinite at a point in the interval of integration is excluded from the syllabus),

Textbooks:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018.

2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2016.

References:

1. Peter V. O'Neil, Advanced Engineering Mathematics, Cengage, 7th Edition, 2012

Assignments

Assignment: Assignment must include applications of the above theory in the concerned engineering branches

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Partial Differential Equations**	
1.1	Partial differential equations, Formation of partial differential equations –elimination of arbitrary constants-elimination of arbitrary functions, Solutions of a partial differential equations, Equations solvable by direct integration,	3
1.2	Linear equations of the first order- Lagrange's linear equation, Non-linear equations of the first order - Charpit's method	3
1.3	Boundary value problems, Method of separation of variables.	2
2	**Applications of Partial Differential Equations**	
2.1	One dimensional wave equation- vibrations of a stretched string, derivation,	1
2.2	Solution of wave equation using method of separation of variables, Fourier series solution of boundary value problems involving wave equation, D'Alembert's solution of the wave equation	4
2.3	One dimensional heat equation, derivation,	1
2.4	Solution of the heat equation, using method of separation of variables, Fourier series solutions of boundary value problems involving heat equation	4

3	**Complex Variable – Differentiation**	
3.1	Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations,	4
3.2	harmonic functions, finding harmonic conjugate,	2
3.3	Conformal mappings- mappingsof $w = z^2, , w = e^z, w = \frac{1}{z}, w = sinz$.	3
4	**Complex Variable – Integration**	
4.1	Complex integration, Line integrals in the complex plane, Basic properties, First evaluation method, second evaluation method, use of representation of a path	4
4.2	Contour integrals, Cauchy integral theorem (**without proof**) on simply connected domain, on multiply connected domain(**without proof**) .Cauchy Integral formula (**without proof**),	2
4.3	Cauchy Integral formula for derivatives of an analytic function,	2
4.3	Taylor's series and Maclaurin series.	1
5	**Complex Variable – Residue Integration**	
5.1	Laurent's series(**without proof**)	2
5.2	zeros of analytic functions, singularities, poles, removable singularities, essential singularities, Residues,	2
5.3	Cauchy Residue theorem (**without proof**), Evaluation of definite integral using residue theorem	2
5.4	Residue integration of real integrals – integrals of rational functions of $cos\theta$and $sin\theta$, integrals of improper integrals of the form $\int_{-\infty}^{\infty} f(x)dx$with no poles on the real axis. ($\int_A^B f(x)dx$**whose integrand become infinite at a point in the interval of integration is excluded from the syllabus**),	3

Model Question Paper

(For all branches except Computer Science and Information Technology)

(2019 Scheme)

Reg No: Name:

APJ ABDULKALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH. DEGREE EXAMINATION

(MONTH & YEAR)

Course Code:

Course Name: PARTIAL DIFFERENTIAL EQUATIONS AND COMPLEX ANALYSIS

MAX.MARKS: 100 DURATION: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1. Derive a partial differential equation from the relation $z = f(x + at) + g(x - at)$
2. Solve $\frac{\partial^2 z}{\partial x \partial y} = x^2 y$
3. State any three assumptions in deriving the one dimensional wave equation
4. What are the possible solutions of one-dimensional heat equation?
5. If $f(z) = u + iv$ is analytic, then show that u *and* v are harmonic functions.
6. Check whether $f(z) = \bar{z}$ is analytic or not.
7. Evaluate $\int_c tan\, z\, dz$ where c is the unit circle.
8. Find the Taylor's series of $f(z) = \frac{1}{z}$ about $z = 2$.
9. What type of singularity have the function $f(z) = \frac{1}{\cos z - \sin z}$
10. Find the residue of $\frac{e^z}{z^3}$ at its pole.

PART B

Answer any one full question from each module, each question carries 14 marks.

Module-I

11. (a) Solve $x(y - z)p + y(z - x)q = z(x - y)$
    (b) Use Charpit's methods to solve $q + xp = p^2$
12. (a) Find the differential equation of all spheres of fixed radius having their centers in the xy-plane.

(b) Using the method of separation of variables, solve $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u$, where $u(x,0) = 6e^{-3x}$.

Module – II

13. (a) Derive the solution of one dimensional wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$ with zero boundary conditions and with initial conditions $u(x,0) = f(x)$ and $\left(\frac{\partial u}{\partial t}\right)_{t=0} = 0$.

(b) A homogeneous rod of conducting material of length 100 cm has its ends kept at zero temperature and the temperature initially is $u(x,0) = \begin{cases} x, 0 \le x \le 50 \\ 100 - x, 50 \le x \le 100 \end{cases}$. Find the temperature $u(x,t)$ at any time.

14. (a) A tightly stretched string of length l with fixed ends is initially in equilibrium position. It is set vibrating by giving each point a velocity $v_0 \sin^3\left(\pi x/l\right)$. Find the displacement of the string at any time.

(b) An insulated rod of length l has its ends A and B are maintained at $0^0 c$ and $100^0 C$ respectively under steady state condition prevails. If the temperature at B is suddenly reduced to $0^0 c$ and maintained at $0^0 c$, Find the temperature at a distance *x* from A at time t.

Module-III

15. (a) Show that $f(z) = e^z$ is analytic for all z. Find its derivative.

(b) Find the image of $|z - 2i| = 2$ under the transformation $w = \frac{1}{z}$

16. (a) Prove that the function $u(x,y) = x^3 - 3xy^2 - 5y$ is harmonic everywhere. Find its harmonic conjugate.

(b) Find the image of the infinite stripe $0 \le y \le \pi$ under the transformation $w = e^z$

Module-IV

17. (a) Evaluate $\int_0^{2+i} (\bar{z})^2 \, dz$, along the real axis to 2 and then vertically to $2 + i$

(b) Using Cauchy's integral formula evaluate $\int_c \frac{5z+7}{z^2+2z-3} dz$, where c is $|z - 2| = 2$

18. (a) Evaluate $\int_c \frac{\sin^2 z}{\left(z - \frac{\pi}{6}\right)^3} dz$, where C is $|z| = 1$.

(b) Expand $\frac{1}{(z-1)(z-2)}$ in the region $|z| < 1$

Module- V

19. (a) Expand $f(z) = \frac{z^2-1}{z^2-5z+6}$ in $2 < |z| < 3$ as a Laurent's series.

(b) Using contour integration evaluate $\int_0^{2\pi} \frac{d\theta}{2+\cos\theta}$

20. (a) Use residue theorem to evaluate $\int_c \frac{\cos h\, \pi z}{z^2+4} dz$ where are C is $|z| = 3$.

(b) Apply calculus of residues to evaluate $\int_{-\infty}^{\infty} \frac{1}{(x^2+1)^3} dx$.

MRT201	ELECTRICAL MACHINES & DRIVES	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble:

This course aims the students to learn about the introduction of all basics machines of electrical and basic concept of machine drives

Prerequisite:

EST-130 BASICS OF ELECTRICAL AND ELECTRONICS

Course Outcomes: After the completion of the course the student will be able to

CO 1	Explain the basic concept of dc generator and motor
CO 2	The basic concepts of transformer and 3 phase induction motor
CO 3	The basic concepts of single phase induction motor and alternators
CO 4	The basic concept of special electrical machines & introduction to power electronics
CO 5	The basic concept of machine drives

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	2	2	1	-	-	-	3
CO2	3	3	2	1	-	2	2	1	-	-	-	3
CO3	3	3	2	1	-	2	2	1	-	-	-	3
CO4	3	1	1	1	-	2	2	1	-	-	-	2
CO5	3	1	1	1	-	2	2	1	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

SYLLABUS

Module 1 – DC MACHINES

DC generator - constructional details and Working principle – EMF equation – types of dc generators – no load and load characteristics of dc generator. DC motor - Working principle - back emf – types of dc motor - equations for torque & power (simple numerical problems) - Necessity of starters and their types—power flow diagram.

Module 2 - TRANSFORMERS & 3-PHASE INDUCTION MOTORS

TRANSFORMERS
Working principle - Construction - core and shell type - emf equation – voltage transformation ratio (simple numerical problems) – concept of ideal transformer- phasor diagram -ideal, no-load, load – short circuit and open circuit test on transformer (basic concept only) - lossesin transformer

3-PHASE INDUCTION MOTORS
Constructional details – operation – concept of rotating magnetic field – slip - torque equation - (simple numerical problems) - torque–slip characteristics – starting methods of 3-pahse induction motors

Module 3 1-PHASE INDUCTION MOTORS &ALTERNATOR

1-PHASE INDUCTION MOTORS- Working principle – double revolving field theory – different types – split phase – capacitor start – capacitor start- run

ALTERNATOR - Constructional details – working principle - emf equation –voltage regulation – determination of voltage regulation – EMF method only (numerical problems).

Module 4 -- SPECIAL ELECTRICAL MACHINES & INTRODUCTION TO POWER ELECTRONICS

SPECIAL ELECTRICAL MACHINES

Universal motor – stepper motor -different types – servomotor (mechanism only) - Synchronous motor

INTRODUCTION TO POWER ELECTRONICS

Introduction – SCR -symbol, construction and modes of operation – V-I characteristics- Basic concepts of Rectifier – single phase half-wave controlled rectifier with R load – fully controlled bridge rectifier with R load – basic concept of inverter

Module 5 --ELECTRICAL DRIVES

Electrical Drives - Parts of electrical drives - Choice of electric drives - Status of DC and AC drives - Dynamics of Electric drives - Fundamental torque equations – Speed torque conventions and multi-quadrant operation - Components of load torque - Nature and classification of load torque – Steadystate stability – load equalization - Three phase Induction motor drives - Stator voltage control - Frequency control - Voltage and frequency control

Text Books

1. J.B. Gupta, Electrical Machines, Katson Books

2. P.S. Bimbhra, Power Electronics, Khanna Publishers, New Delhi

3. Gopal K. Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, New Delhi.

Reference Books

1. Theraja B.L., Theraja A.K. A Text Book of Electrical Technology, Vol.II “AC & DC Machines”, publication division of Nirja construction & development (p) Ltd., New Delhi, 1994.

2. V.K. Mehta, Rohit Mehta, Principles Of Electrical Machines, S Chand Publication

3. M. H. Rashid, Power Electronics Circuits, Devices and Applications, Pearson Education

4.VedamSubrahmanyam, Electric Drives, Concepts & Applications, Tata McGraw Hill Education Pvt. Ltd, New Delhi

Model Question paper

QP CODE:

Reg. No:----------

Name: ----------

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course code: MRT 201 **Duration: 3hours**

ELECTRICAL MACHINES & DRIVES

(2019- Scheme)

Mechatronics Branch

PART A

*(Answer **all** the questions, each question carries 3 marks)*

1. Explain different types of DC motor according to the excitation method.
2. Explain back EMF and its significance.
3. Narrate the properties of ideal transformer. Sketch its phasor diagram
4. Sketch and explain Torque-Slip characteristics of 3 phase induction motor.
5. Explain the working principle of single phase induction motor.
6. Briefly explain the construction of alternator
7. Briefly explain different types of stepper motor.
8. Draw and explain the V-I characteristics of SCR.
9. Describe the block diagram of electrical drives.
10. Briefly explain the fundamentals of torque equation.

PART B

*(Answer **one** full question from each module .each question carries 14 marks)*

Module 1

11. (a) With neat sketch explain No load and load characteristics of dc generator. (10 marks)

    (b) Explain back EMF and its significance. (4 marks)

12. (a) Explain the working of three point starter . (10 marks)

    (b) Derive equation for torque of a dc motor. (4 marks)

Module 2

12. (a) Explain the phasor diagram of transformer. (10 marks)

(b) Derive emf equation of a transformer. (4 marks)

13. Explain the starting methods of three phase induction motors . (14 marks)

Module 3

14. (a) Explain different types of single phase induction motors. (10 marks)

    (b) Why single phase induction motors are not self-starting. (4 marks)

15. Narrate the steps for obtaining the voltage regulation of alternator using emf method . (14 marks)

Module 4

16. Explain different types of stepper motor. (14 marks)

17. (a)Explain the modes of operation of SCR. (10 marks)

    (b) Explain the basic concept of a rectifier circuit. (4 marks)

Module 5

18. Explain with neat sketch the multi quadrant operation . (14 marks)

19. Explain in detail the stator voltage control of a motor drive. (14 marks)

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**DC MACHINES**	
1.1	DC generator - constructional details and Working principle	2
1.2	EMF equation – types of dc generators	1
1.3	No load and load characteristics of dc generator.	2
1.4	DC motor - Working principle - back emf – types of dc motor	1
1.5	equations for torque & power (simple numerical problems)	2
1.6	Necessity of starters and their types—power flow diagram	2
2	**TRANSFORMERS**	
2.1	Working principle - Construction - core and shell type	1
2.2	emf equation – voltage transformation ratio (simple numerical problems)	1
2.3	concept of ideal transformer- phasor diagram - ideal, no-load, load	2
2.4	short circuit and open circuit test on transformer - losses in transformer	1

	3-PHASE INDUCTION MOTORS	
2.5	Constructional details – operation – concept of rotating magnetic field	2
2.6	slip - torque equation - (simple numerical problems) - torque–slip characteristics	2
2.7	starting methods of 3-pahse induction motors	1
3	**1-PHASE INDUCTION MOTORS**	
3.1	Working principle – double revolving field theory – different types	1
3.2	split phase – capacitor start – capacitor start- run	1
	ALTERNATOR	
3.3	Constructional details – working principle	2
3.4	emf equation – voltage regulation	1
3.5	determination of voltage regulation – EMF method	3
4	**SPECIAL ELECTRICAL MACHINES**	
4.1	Universal motor	1
4.2	stepper motor -different types	2
4.3	servomotor (mechanism only)	1
4.4	Synchronous motor	1
	INTRODUCTION TO POWER ELECTRONICS	
4.5	Introduction – SCR - symbol, construction and modes of operation	2
4.6	V-I characteristics	1
4.7	Basic concepts of Rectifier – single phase half-wave controlled rectifier with R load – fully controlled bridge rectifier with R load	1
4.8	basic concept of inverter	1
5	**ELECTRICAL DRIVES**	
5.1	Electrical Drives - Parts of electrical drives - Choice of electric drives - Status of DC and AC drives - Dynamics of Electric drives	1
5.2	Fundamental torque equations – Speed torque conventions and multi-quadrant operation	2
5.3	Components of load torque - Nature and classification of load torque – Steady state stability – load equalization	2
5.4	Stator voltage control - Frequency control	1
5.5	Voltage and frequency control	1

MRT 203	ANALOG AND DIGITAL ELECTRONICS	CATEGORY	L	T	P	CREDIT
		PCC	3	1	-	4

Preamble:

This course enables students to analyse, design and implement analog and digital circuits and systems for the given specification and function.

Prerequisite:*Basics of Electronics*

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the working of amplifiers and oscillators.
CO 2	Familiarisation of Op-amp and its different applications.
CO 3	Analysis of multivibrators and principles of PLL.
CO 4	Learn different simplification methods in digital electronics and also learn to design its combinational circuits
CO 5	Design of sequential circuits.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	2	1	2	-	-	-	-	-
CO2	3	3	2	1	2	1	2	-	-	-	-	-
CO3	3	3	2	1	2	1	2	-	-	-	-	-
CO4	3	3	3	1	2	1	2	-	-	-	-	-
CO5	3	3	3	1	2	1	2	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (100 marks)
	Test 1	Test 2	
Remember	5	5	10
Understand	10	10	20
Apply	20	15	30
Analyse	10	10	15
Evaluate	5	5	15
Create		5	10

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. List out the applications of oscillators
2. Differentiate positive feedback from negative feedback.
3. Compare BJT with FET .Mention the usage of both.

Course Outcome 2 (CO2) :

1. Define offset current and offset voltage.
2. What are the characteristics of an ideal opamp?
3. Mention the disadvantages of ideal differentiator. Suggest a method to overcome it.
4. Explain the importance of isolation amplifier.
5. Design an inverting amplifier of gain 10.

Course Outcome 3(CO3):

1. Discuss on the output waveforms of different filters.
2. Design a circuit to generate a waveform of duty cycle 50%.
3. List out the applications of astable and monostablemultivibrator.
4. Define capture range and lock range.
5. Explain any one application of PLL.

Course Outcome 4 (CO4):

1. Why are NAND and NOR called as universal gates?Justify.
2. State and prove De-Morgan's Theorems.
3. Reduce f= ∑ m(0,2,4,6,7,8,10,12,13,15) using K-map& Quine Mc Cluskey Method.
4. Implement the function F(a,b,c,d)= ab' + bd +b'cd' using 8:1 MUX.

Course Outcome 5 (CO5):

1. Explain race round condition.
2. Differentiate combinational circuit form sequential circuits.
3. Design a3 bit synchronous down counter.
4. Explain ring counters with neat diagram.

Model Question paper

QP CODE:

Reg. No:----------

Name: ----------

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course code: MRT 203 **Duration :3hours**

ANALOG AND DIGITAL ELECTRONICS

(2019- Scheme)

Mechatronics Branch

PART A

*(Answer **all** the questions, each question carries 3 marks)*

1. Explain the working of Hartley Oscillators.
2. Compare Class A with Class B amplifiers.
3. Briefly explain S/H circuit using opamp.
4. Design a non inverting amplifier of gain 11.Given input voltage is 2 Vpp.
5. Derive an expression for calculating gain of a first order active LPF.
6. Explain the principle of PLL.
7. Reduce the expression f= ΠM (0,1,2,3,4,7) using mapping and implement it in AOI logic.
8. Design a full adder circuit using universal gates.
9. Discuss on twisted ring counter.
10. Design a 2 bit ripple up-down counter using negative edge triggered flip flops.

PART B

*(Answer **one** full question from each module .each question carries 14 marks)*

Module 1

11. (a) Explain the construction, working and characteristics of depletion MOSFET.

(10 marks)

(b) State and explain the condition for sustained oscillations.(4 marks)

12. (a) Explain the working of RC phase shift oscillators .Derive an expression for resonant frequency. (10 marks)

(b) Explain how tank circuits aid in oscillations. (4 marks)

Module 2

12. (a)Explain ideal integrator using opamp.Suggest method to overcome its disadvantages. (10 marks)

    (b) List out the characteristics of op-amp. (4 marks)

13. (a) Explain V-I and I-V converters. (9 marks)

    (b) Write notes on isolation amplifier. (5 marks)

Module 3

14. (a) Explain the importance of VCO. (4 marks)

    (b) Define duty cycle . Explain the working of monostablemultivibrator. (10 marks)

15. (a) Distinguish band pass and band stop filters. (6 marks)

    (b) Explain the functional diagram of IC 555. (8 marks)

Module 4

16. (a) Design and implement 3 bit gray to binary code converter. (8 marks)

    (b) Implement F(x,y,z)= ∑ m (0,2,3,5) using 8 to 1 MUX. (6 marks)

17. Using tabular method , obtain minimal expression for f=∑ m (6,7,8,9) + d(10,11,12,13,14,15). (14 marks)

Module 5

18. Design a Mod-6 asynchronous counter using T FFs. (14 marks)

19. Design 3 bit synchronous up counter using JK Flip flops. (14 marks)

Syllabus

Module 1-Amplifiers & Oscillators (9 hours)

BJT as an amplifier (CE configuration) - Concept of feedback-FET-construction and characteristics of JFET & MOSFET-Comparison of BJT & FET.Power amplifiers-class A,B,AB & C amplifiers.Oscillators-Barkhausen criteria-Classification- analysis of RC phase shift oscillators-Working of Hartley and Colpitts Oscillator.

Module 2- Op-amp & its applications (9 hours)

Op-amp –ideal characteristics –offset voltage & offset current –frequency response-voltage series feedback and shunt feedback amplifiers- Integrator , Differentiator- Comparator, S/H, Isolation amplifier, V/I & I/V Converter.

Module 3- Filters &Timers (9 hours)

Active Filters- Analysis of first order LPF & HPF filter- Working of Band Pass & Band stop Filters- Timer IC 555 –Functional diagram, Astable and Monostable modes. Phase Locked Loops-Principles-building blocks of PLL-VCO-lock and capture ranges-capture process-frequency multiplication using PLL.

Module 4- Digital circuits (9 hours)

Logic gates-De-Morgan's theorem –Minimization of Boolean function using K-Map and Quine Mc Cluskey method. Combinational Circuits- Adder, Subtractor, Code converters (gray to binary & binary to gray). Encoders(3x8), Decoders(8x3), Multiplexers (1x8), De-multiplexers (8x1).

Module 5-Sequential Circuits (9 hours)

Flip Flop –SR,D,JK,T and master slave flip flop- Shift Registers- Counters –3 bit Synchronous and asynchronous- Modulo 3 Counter- Ring Counter, Sequence detector

Text Books

1. Robert L.Boylestad and Louis Nashelsky, "*Electronic Devices and Circuit Theory*", Prentice Hall, Tenth Edition, 2009.

2.Ramakant A Gayakward, "*Op-amps and Linear Integrated* Circuits", IV edition ,Pearson Education,2002

3.M.Morris Mano, "*Digital Logic and Computer Design*", Pearson Education,2002

Reference Books

1. Allen Mottershead, "*Electronic Devices and Circuits:AnIntroduction*",Prentice Hall of India,2013

2.D.RoyChoudhury,Shail B Jain, "*Linear Integrated Circuits*",Fifthedition,New Age ,2018

3.Thomas L Floyd, "*Digital Fundamentals*",Eleventhedition,Pearson Education,2011

4. A.Anand Kumar, "*Fundamentals of Digital Circuits*",Second Edition,PHI,2009

Course Contents and Lecture Schedule

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No	Topic	No. of Lectures
1	**Amplifiers and Oscillators**	
1.1	BJT as an amplifier(CE configuration)- concept of feedback	1
1.2	FET- Construction and characteristics of JFET & MOSFET, Comparison of BJT & FET	2
1.3	Power Amplifiers- Class A,B,AB,C amplifiers	3
1.4	Oscillators-Barkhausen criteria-Classification	1
1.5	Operation and analysis of RC phase shift oscillators	1
1.6	Working of Hartley and ColpittsOscillators	1
2	**OP-AMP & its Applications**	
2.1	Ideal characteristics, offset voltage and offset current, frequency response	2

2.2	Voltage shunt feedback and voltage series feedback amplifiers	1
2.3	Applications : Integrator , Differentiator&Schmitt Trigger	3
2.4	Comparator, S/H, Isolation amplifier,V/I&I/V Converter	3
3	**Filters & Timers**	
3.1	Active Filters- Analysis of first order LPF & HPF filter	1
3.2	Working of Band Pass & Band stop Filters	2
3.3	Timer IC 555 –Functional diagram ,Astable and Monostable modes	3
3.4	Phase Locked Loops-Principles- building blocks of PLL-importance of VCO-lock and capture ranges-capture process-frequency multiplication using PLL	3
4	**Digital Circuits**	
4.1	Logic gates-De-Morgan's theorem –Minimization of Boolean function using K-Map (3 & 4 variables) and Quine Mc Cluskey method.	3
4.2	Combinational Circuits- Adder,Subtractor,Code converters (gray to binary & binary to gray)	2
4.3	Encoders(3x8),Decoders(8x3),	2
4.4	Multiplexers (1x8), De-multiplexers (8x1)	2
5	**Sequential Circuits**	
5.1	Flip Flop –SR,D,JK,T and master slave flip flop	2
5.2	Shift Registers	1
5.3	Counters –3 bit Synchronous and asynchronous	2
5.4	Up-Down Counters	1
5.5	ModulonCounter	1
5.6	Ring Counter, Sequence detector	2

MRT205	MECHANICS OF SOLIDS	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble:

This course helps the students to understand the concept of stress and strain in different types of structure/machine under various loading conditions. The course also covers simple and compound stresses due to forces, stresses and deflection in beams due to bending, torsion in circular section, strain energy, different theories of failure, stress in thin cylinder thick cylinder and spheres due to external and internal pressure.

Prerequisite: EST100 ENGINEERING MECHANICS

Course Outcomes:

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

CO 1	Determine the stresses, strains and displacements of structures by tensorial and graphical (Mohr's circle) approaches
CO 2	Analyse the strength of materials using stress-strain relationships for structural and thermal loading
CO 3	Perform basic design of shafts subjected to torsional loading and analyse beams subjected to bending moments
CO 4	Determine the deformation of structures subjected to various loading conditions using strain energy methods
CO 5	Estimate the strength of thin cylinders, spherical vessels and columns, and appreciate the theories of failures and its relevance in mechanical design

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2									1
CO 2	3	3	2									1
CO 3	3	3	1									2
CO 4	3	3	1									1
CO 5	3	3	1									1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember			
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	50
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module and having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have a maximum of 2 subdivisions.

COURSE LEVEL ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Determine the resultant traction at a point in a plane using the stress tensor.

2. Evaluate the principal stresses, principal strains and their directions from a given state of stress or strain.

3. Write the stress tensor and strain tensor.

Course Outcome 2 (CO2)

1. Write the generalized Hooke's law for stress-strain relations.

2. Estimate the state of strain from a given state of stress.

3. Analyse the strength of a structure subjected to thermal loading.

Course Outcome 3(CO3):

1. Design a shaft to transmit power and torque.

2. Draw the shear force and bending moment diagrams.

3. Determine the bending stress on a beam subjected to pure bending.

Course Outcome 4 (CO4):

1. Apply strain energy method to estimate the deformation of a structure.

2. Use strain energy method to calculate deformations for multiple loads.

3. Use strain energy method to estimate the loads acting on a structure for a maximum deflection.

Course Outcome 5 (CO5):

1. Analyse a column for buckling load.

2. A bolt is subjected to a direct tensile load of 20 kN and a shear load of 15 kN. Suggest suitable size of this bolt according to various theories of elastic failure, if the yield stress in simple tension is 360 MPa. A factor of safety 2 should be used. Assume Poisson's ratio as 0.3.

3. Estimate the stresses on a thin cylinder or spherical vessel.

SYLLABUS

Module 1

Deformation behaviour of elastic solids in equilibrium under the action of a system of forces, method of sections. Stress vectors on Cartesian coordinate planes passing through a point, stress at a point in the form of a matrix. Equality of cross shear, Cauchy's equation. Displacement, gradient of displacement, Cartesian strain matrix, strain- displacement relations (small-strain only), Simple problems to find strain matrix.Stress tensor and strain tensor for plane stress and plane strain conditions. Principal planes and principal stress, meaning of stress invariants, maximum shear stress. Mohr's circle for 2D case.

Module 2

Stress-strain diagram, Stress–Strain curves of Ductile and Brittle Materials, Poisson's ratio.

Constitutive equations-generalized Hooke's law, equations for linear elastic isotropic solids in in terms of Young's Modulus and Poisson's ratio, Hooke's law for Plane stress and plane strain conditions Relations between elastic constants E, G, v and K.

Calculation of stress, strain and change in length in axially loaded members with single and composite materials, Effects of thermal loading – thermal stress and thermal strain. Thermal stress on a prismatic bar held between fixed supports.

Module 3

Torsional deformation of circular shafts, assumptions for shafts subjected to torsion within elastic deformation range, derivation of torsion formula Torsional rigidity, Polar moment of inertia, basic design of transmission shafts. Simple problems to estimate the stress in solid and hollow shafts. Shear force and bending moment diagrams for cantilever and simply supported beams. Differential equations between load, shear force and bending moment. Normal and shear stress in beams: Derivation of flexural formula, section modulus, flexural rigidity, numerical problems to evaluate bending stress, economic sections. Shear stress formula for beams: Derivation, shear stress distribution for a rectangular section.

Module 4

Deflection of beams using Macauley's method

Elastic strain energy and Complementary strain energy. Elastic strain energy for axial loading, transverse shear, bending and torsional loads. Expressions for strain energy in terms of load, geometry and material properties of the body for axial, shearing, bending and torsional loads.

Castigliano's second theorem, reciprocal relation, proof for Castigliano's second theorem. Simple problems to find the deflections using Castigliano's theorem.

Module 5

Fundamentals of bucking and stability, critical load, equilibrium diagram for buckling of an idealized structure. Buckling of columns with pinned ends, Euler's buckling theory for long columns. Critical stress, slenderness ratio, Rankine's formula for short columns.

Introduction to Theories of Failure, Rankine's theory for maximum normal stress, Guest's theory for maximum shear stress, Saint-Venant's theory for maximum normal strain, Hencky-von Mises theory for maximum distortion energy, Haigh's theory for maximum strain energy

Circumferential and Longitudinal stress in a thin cylindrical vessel, stresses in a thin spherical vessel

Text Books

1. Mechanics of materials in S.I.units, R .C. Hibbeler, Pearson Higher Education 2018

2. Advanced Mechanics of Solids, L. S. Srinath, TMH

3. Design of Machine Elements, V. B Bhandari

Reference Books

1. Strength of Materials, Surendra Singh, S. K. Kataria& Sons

2. Engineering Mechanics of Solids, Popov E., PHI 2002

3. Mechanics of Materials S. I. units, Beer, Johnston, Dewolf, McGraw Hills 2017

4. Mechanics of Materials, Pytel A. and Kiusalaas J. Cengage Learning India Private Limited, 2nd Edition, 2015

5. Strength of Materials, Rattan, McGraw Hills 2011

COURSE PLAN

No	Topic	No of lectures
1	Module 1: Stress and Strain Analysis	9 hours
1.1	Describe the deformation behaviour of elastic solids in equilibrium under the action of a system of forces. Describe method of sections to illustrate stress asresisting force per unit area. Stress vectors on Cartesian coordinate planes passing through a point and writing stress at a point in the form of a matrix.	2 hr
1.2	Equality of cross shear (Derivation not required). Write Cauchy's equation (Derivation not required),Find resultant stress, Normal and shear stress on a plane given stress tensor and direction cosines (no questions for finding direction cosines).	2 hr
1.3	Displacement, gradient of displacement, Cartesian strain matrix, Write strain- displacement relations (small-strain only), Simple problems to find strain matrix given displacement field (2D and 3D), write stress tensor and strain tensor for Plane stress and plane strain conditions.	1 hr
1.4	Concepts of principal planes and principal stress, characteristic equation of stress matrix and evaluation of principal stresses and principal planes as an eigen value problem, meaning of stress invariants, maximum shear stress	2 hrs
1.5	Mohr's circle for 2D case: find principal stress, planes, stress on an arbitrary plane, maximum shear stress graphically using Mohr's circle	2 hrs
2	Module 2: Stress - Strain Relationships	9 hours
2.1	Stress-strain diagram, Stress–Strain curves of Ductile and Brittle Materials, Poisson's ratio	1 hr
2.2	Constitutive equations-generalized Hooke's law, equations for linear elastic isotropic solids in in terms of Young's Modulus and Poisson's ratio (3D). Hooke's law for Plane stress and plane strain conditions Relations between elastic constants E, G, v and K, Numerical problems	2 hrs
2.3	Calculation of stress, strain and change in length in axially loaded members with single and composite materials, Effects of thermal loading – thermal stress and thermal strain. Thermal stress on a prismatic bar held between fixed supports.	2 hrs
2.4	Numerical problems for axially loaded members	4 hrs
3	Module 3: Torsion of circular shafts, Shear Force-Bending Moment Diagrams and Pure bending	9 hours
3.1	Torsional deformation of circular shafts, assumptions for shafts subjected to torsion within elastic deformation range, derivation of torsion formula	1 hr
3.2	Torsional rigidity, Polar moment of inertia, comparison of solid and hollow shaft. Simple problems to estimate the stress in solid and hollow shafts	1 hr
3.3	Numerical problems for basic design of circular shafts subjected to	1 hr

	externally applied torques	
3.4	Shear force and bending moment diagrams for cantilever and simply supported beams subjected to point load, moment, UDL and linearly varying load	2 hrs
3.5	Differential equations between load, shear force and bending moment.	1 hrs
3.6	Normal and shear stress in beams: Derivation of flexural formula, section modulus, flexural rigidity, numerical problems to evaluate bending stress, economic sections Shear stress formula for beams: Derivation, numerical problem to find shear stress distribution for rectangular section	3 hrs
4	Module 4: Deflection of beams, Strain energy	8 hours
4.1	Deflection of cantilever and simply supported beams subjected to point load, moment and UDL using Macauley's method (procedure and problems with multiple loads)	2 hrs
4.2	Linear elastic loading, elastic strain energy and Complementary strain energy. Elastic strain energy for axial loading, transverse shear, bending and torsional loads (short derivations in terms of loads and deflections).	2 hr
4.3	Expressions for strain energy in terms of load, geometry and material properties of the body for axial, shearing, bending and torsional loads. Simple problems to solve elastic deformations	2 hrs
4.4	Castigliano's second theorem to find displacements, reciprocal relation, proof for Castigliano's second theorem.	1 hr
4.5	Simple problems to find the deflections using Castigliano's theorem	1 hr
5	Module 5: Buckling of Columns, Theories of Failure, Thin pressure vessels	8 hours
5.1	Fundamentals of bucking and stability, critical load, Euler's formula for long columns, assumptions and limitations, effect of end conditions(derivation only for pinned ends), equivalent length	2 hr
5.2	Critical stress, slenderness ratio, Rankine's formula for short columns, Problems	2 hr
5.3	Introduction to Theories of Failure. Rankine's theory for maximum normal stress, Guest's theory for maximum shear stress, Saint-Venant's theory for maximum normal strain	1 hr
5.4	Hencky-von Mises theory for maximum distortion energy, Haigh's theory for maximum strain energy	1 hr
5.5	Circumferential and Longitudinal stress in a thin cylindrical vessel, stresses in a thin spherical vessel (short derivations) and numerical problems	2 hrs

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION

Course Code : MRT205

Course Name : MECHANICS OF SOLIDS

Max. Marks : 100 Duration : 3 Hours

PART – A

(ANSWER ALL QUESTIONS, EACH QUESTION CARRIES 3 MARKS)

1. Express the stress invariants in terms of Cartesian components of stress and principal stress.
2. Write down the Cauchy's strain displacement relationships.
3. Distinguish between the states of plane stress and plane strain.
4. Represent the generalized Hooke's law for a Linear elastic isotropic material.
5. List any three important assumptions in the theory of torsion.
6. Write the significance of flexural rigidity and section modulus in the analysis of beams.
7. Discuss reciprocal relation for multiple loads on a structure.
8. Express the strain energy for a cantilever beam subjected to a transverse point load at free end.
9. Discuss Saint-Venant's theory of failure.
10. Compare the strength of a thin spherical vessel and a thin cylindrical vessel on the basis of hoop stress.

PART – B

(ANSWER ONE FULL QUESTION FROM EACH MODULE)

MODULE – 1

11.a) The state of stress at a point is given by σ_{xx} = 12.31 MPa, σ_{yy} = 8.96 MPa, σ_{zz} = 4.34 MPa, τ_{xy} = 4.2 MPa, τ_{yz} = 5.27 MPa, τ_{xz} = 0.84 MPa. Determine the principal stresses. (7 marks) b) The displacement field for a body is given by u= $(x^2 + y)i + (3 + z)\,j + (x^2 + 2y)k$. What is the deformed position of a point originally at (3,1,–2)? Write the strain tensor at the point (−3,−1,2).

(7 marks)

OR

12.a) The state of plane stress at a point is given by σ_{xx} = 40 MPa, σ_{yy} = 20 MPa andτ_{xy} = 16 MPa. Using Mohr's circle determine the i) principal stresses and principal planes and ii) maximum shear stress. (7 marks) b) The state of stress at a point is given below. Find the resultant stress vector acting on a plane with direction cosines n_x=0.47, n_y=0.82 and n_z=0.33. Find the normal and tangential stresses acting on this plane. (7 marks)

$$\sigma_{ij} = \begin{bmatrix} 10 & 5 & -10 \\ 5 & 20 & -15 \\ -10 & -15 & -10 \end{bmatrix} MPa$$

MODULE – 2

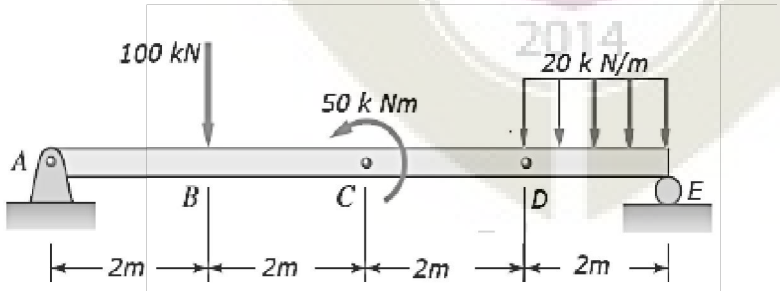
13.a) Calculate Modulus of Rigidity and Young's Modulus of a cylindrical bar of diameter 30 mm and of 1.5 m length if the longitudinal strain in a bar during a tensile stress is four times the lateral strain. Find the change in volume when the bar is subjected to a hydrostatic pressure of 100 N/mm^2. Take E = 10^5 N/mm (9 marks) b) A straight bar 450 mm long is 40 mm in diameter for the first 250 mm length and 20 mm diameter for the remaining length. If the bar is subjected to an axial pull of 15 kNfind the maximum axial stress produced and the total extension of the bar. Take E = 2x10^{5}N/mm^2 (5 marks)

OR

14.a) A brass bar 20mm diameter is enclosed in a steel tube of 25mm internal diameter and 50mm external diameter. Both bar and tube is of same length and fastened rigidly at their ends. The composite bar is free of stress at 20°C. To what temperature the assembly must be heated to generate a compressive stress of 48MPa in brass bar? Also determine the stress in steel tube. E_{steel} = 200GPa and E_{brass} = 84GPa, α_{steel} = 12 × 10^{-6} / °C and α_{brass}= 18 × 10^{-6} / °C. (9 marks)

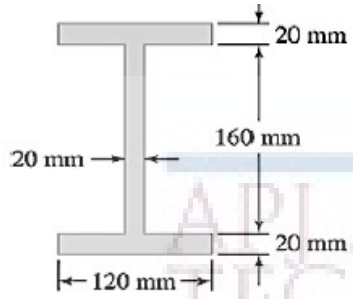
b) Draw the stress-strain diagram for a ductile material and explain the salient points.
(5 marks) MODULE – 3

15.a) Draw shear force and bending moment diagram for the beam given in the figure. (9 marks)



b) Compare the strength of a hollow shaft of diameter ratio 0.75 to that of a solid shaft by considering the permissible shear stress. Both the shafts are of same material, of same length and weight. (5 marks) OR

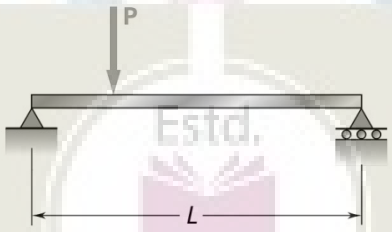
16.a) A simply supported beam of span of 10 m carries a UDL of 40 kN/m. The cross section is of I shape as given below. Calculatethe maximum stress produced due to bending and plot thebending stress distribution. (9 marks)



b) The shear stress of a solid shaft is not to exceed 40 N/mm^2 when the power transmitted is 20 kW at 200 rpm. Determine the minimum diameter of the shaft. (5 marks) MODULE – 4

17.a) A horizontal girder of steel having uniform section is 14 m long and is simply supported at its ends. It carries concentrated loads of 120 kN and 80 kN at two points 3 m and 4.5 m from the two ends respectively. Moment of inertia for the section of the girder is 16 × 10^8 mm^4 and E_s = 210 kN/mm^2. Calculate the deflection of the girder at points under the two loads and maximum deflection using Macaulay's method. (8 marks) b) Derive the expressions for elastic strain energy in terms of applied load/moment and material property for the cases of a) Axial force b) Bending moment. (6 marks) OR

18.a) Calculate the displacement in the direction of load P applied at a distance of L/3 from the left end for a simply supported beam of span L as shown in the figure.



(8 marks)

b) State and prove Castigliano's second theorem. (6 marks)

MODULE – 5

19.a) Find the crippling load for a hollow steel column 50mm internal diameter and 5mm thick. The column is 5m long with one end fixed and other end hinged. Use Rankine's formula and Rankine's constant as 1/7500 and σ_c = 335 N/mm^2. Compare this load by crippling load given by Euler's formula. Take E = 110 GPa. (8 marks) b) Explain the maximum normal stress theory, maximum strain energy theory and maximum shear stress theory of failure. (6 marks)

OR

20.a) A cylindrical shell 3m long closed at the ends has an internal diameter of 1m and wall thickness 15mm. Calculate the circumferential and longitudinal stresses induced and also the change in dimensions of the shell, if it is subjected to an internal pressure of 1.5MPa. Take E = 2×10^5 N/mm^2 and $\nu = 0.3$. (9 marks)

b) Derive Euler's formula for a column with both ends hinged. (5 marks)

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
			2	0	0	2
EST 200	DESIGN AND ENGINEERING					

Preamble:

The purpose of this course is to

i) introduce the undergraduate engineering studentsthe fundamental principles of design engineering,

ii) make them understand the steps involved in the design process and

iii) familiarize them with the basic tools used and approaches in design.

Students are expected to apply design thinking in learning as well as while practicing engineering, which is very important and relevant for today. Case studies from various practical situations will help the students realize that design is not only concerned about the function but also many other factors like customer requirements, economics, reliability, etc. along with a variety of life cycle issues.

The course will help students to consider aesthetics, ergonomics and sustainability factors in designs and also to practice professional ethics while designing.

Prerequisite:

Nil. The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines.

Course Outcomes:

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

CO 1	Explain the different concepts and principles involved in design engineering.
CO 2	Apply design thinking while learning and practicing engineering.
CO 3	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1					1			1		
CO 2		2				1		1				2
CO 3			2			1	1		2	2		1

Assessment Pattern

Continuous Internal Evaluation (CIE) Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination (ESE) Pattern: There will be two parts; Part A and Part B.
Part A : 30 marks
part B : 70 marks
Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.
Part B contains 2 case study questions from each module of which student should answer any one. Each question carry 14 marks and can have maximum 2 sub questions.

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	10	10	20
Apply	35	35	70
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Level Assessment Questions

Course Outcome 1 (CO1): Appreciate the different concepts and principles involved in design engineering.

1. State how engineering design is different from other kinds of design

2. List the different stages in a design process.

3. Describedesign thinking.

4. State the function of prototyping and proofing in engineering design.

5. Write notes on the following concepts in connection with design engineering 1) Modular Design, 2) Life Cycle Design , 3) Value Engineering, 4) Concurrent Engineering, and 5) Reverse Engineering

6. State design rights.

Course Outcome 2 (CO2) Apply design thinking while learning and practicing engineering.

1. Construct the iterative process for design thinking in developing simple products like a pen, umbrella, bag, etc.

2. Show with an example how divergent-convergent thinking helps in generating alternative designs and then how to narrow down to the best design.

3. Describe how a problem-based learning helps in creating better design engineering solutions.

4. Discuss as an engineer, how ethics play a decisive role in your designs

Course Outcome 3(CO3): Develop innovative, reliable, sustainable and economically viable designs incorporating different segments of knowledge in engineering.

1. Illustratethe development of any simple product by passing through the different stages of design process

2. Show thegraphical design communication with the help of detailed 2D or 3D drawings for any simple product.

3. Describe how to develop new designs for simple products through bio-mimicry.

Model Question paper

Page 1 of 2

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: EST 200

Course Name: DESIGN AND ENGINEERING

Max. Marks: 100Duration: 3 Hours

PART A

Answer all questions, each question carries 3 marks
Use only hand sketches

(1)Write aboutthe basic design process.

(2) Describe how to finalize the design objectives.

(3) State the role of divergent-convergent questioning in design thinking.

(4) Discuss how to perform design thinking in a team managing the conflicts.

(5) Show how engineering sketches and drawings convey designs.

(6)Explain the role of mathematics and physics in design engineering process.

(7) Distinguish between project-based learning and problem-based learning in design engineering.

(8) Describe how concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?

(9) Show how designs are varied based on the aspects of production methods, life span, reliability and environment?

(10) Explain how economics influence the engineering designs?

(10x3 marks =30 marks)

Part B

Answer any ONE question from each module. Each question carry 14 marks

Module 1

(11) Show the designing of a wrist watch going through the various stages of the design process. Use hand sketches to illustrate the processes.

or

(12)Find the customer requirements for designing a new car showroom. Show how the design objectives were finalized considering the design constraints?

Module 2

(13)Illustrate the design thinking approach for designing a bag for college students within a limited budget. Describe each stage of the process and the iterative procedure involved. Use hand sketches to support your arguments.

or

(14)Construct a number of possible designs and then refine them to narrow down to the best design for a drug trolley used in hospitals. Show how the divergent-convergent thinking helps in the process. Provide your rationale for each step by using hand sketches only.

Module 3

(15) Graphically communicate the design of a thermo flask used to keep hot coffee. Draw the detailed 2D drawings of the same with design detailing, material selection, scale drawings, dimensions, tolerances, etc. Use only hand sketches.

or

(16)Describe the role of mathematical modelling in design engineering. Show how mathematics and physics play a role in designing a lifting mechanism to raise 100 kg of weight to a floor at a height of 10 meters in a construction site.

Module 4

(17) Show the development of a nature inspired design for a solar poweredbus waiting shed beside a highway. Relate between natural and man-made designs. Use hand sketches to support your arguments.

or

(18)Show the design of a simple sofa and then depict how the design changes when considering 1) aesthetics and 2) ergonomics into consideration. Give hand sketches and explanations to justify the changes in designs.

Module 5

(19)Examine the changes in the design of a foot wear with constraints of 1) production methods, 2) life span requirement, 3) reliability issues and 4) environmental factors. Use hand sketches and give proper rationalization for the changes in design.

or

(20)Describe the how to estimate the cost of a particular design using ANY of the following: i) a website, ii) the layout of a plant, iii) the elevation of a building, iv) anelectrical or electronic system or device and v) a car.

Show how economics will influence the engineering designs. Use hand sketches to support your arguments.

(5x14 marks =70 marks)

Syllabus

Module 1

Design Process:- Introduction to Design and Engineering Design, Defining a Design Process-:Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

Module 2

Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment.

Module 3

Design Communication (Languages of Engineering Design):-Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design.

Module 4

Design Engineering Concepts:-Project-based Learning and Problem-based Learning in Design.Modular Design and Life Cycle Design Approaches. Application of Bio-mimicry,Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.

Module 5

Expediency, Economics and Environment in Design Engineering:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design

Text Books

1) YousefHaik, SangarappillaiSivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning 2003, Third Edition, ISBN-10: 9781305253285,

2) Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

Reference Books

1.Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition, ISBN: 9780128012420.

2. Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5

3. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361

4. Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1: Design Process**	
1.1	Introduction to Design and Engineering Design. *What does it mean to design something? How Is engineering design different from other kinds of design? Where and when do engineers design? What are the basic vocabularyin engineering design? How to learn and do engineering design.*	1
1.2	*Defining a Design Process*-: Detailing Customer Requirements. *How to do engineering design? Illustrate the process with an example. How to identify the customer requirements of design?*	1
1.3	*Defining a Design Process*-: Setting Design Objectives, Identifying Constraints, Establishing Functions. *How to finalize the design objectives? How to identify the design constraints? How to express the functions a design in engineering terms?*	1
1.4	*Defining a Design Process*-: Generating Design Alternatives and Choosing a Design. *How to generate or create feasible design alternatives? How to identify the "best possible design"?*	1
1.5	Case Studies:- Stages of Design Process. *Conduct exercises for designing simple products going through the different stages of design process.*	1
2	**Module 2: Design Thinking Approach**	
2.1	Introduction to Design Thinking *How does the design thinking approach help engineers in creating innovative and efficient designs?*	1
2.2	Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. *How can the engineers arrive at better designs utilizing the iterative design thinking process (in which knowledge acquired in the later stages can be applied back to the earlier stages)?*	1
2.3	Design Thinking as Divergent-Convergent Questioning. *Describe how to create a number of possible designs and then how to refine and narrow down to the 'best design'.*	1
2.4	Design Thinking in a Team Environment. *How to perform design thinking as a team managing the conflicts ?*	1
2.5	Case Studies: Design Thinking Approach. *Conduct exercises using the design thinking approach for*	1

	designing any simple products within a limited time and budget	
3	**Module 3: Design Communication (Languages of Engineering Design)**	
3.1	Communicating Designs Graphically. *How do engineering sketches and drawings convey designs?*	1
3.2	Communicating Designs Orally and in Writing. *How can a design be communicated through oral presentation or technical reports efficiently?*	1
	First Series Examination	
3.3	Mathematical Modelling in Design. *How do mathematics and physics become a part of the design process?*	1
3.4	Prototyping and Proofing the Design. *How to predict whether the design will function well or not?*	1
3.5	Case Studies: Communicating Designs Graphically. *Conduct exercises for design communication through detailed 2D or 3D drawings of simple products with design detailing, material selection, scale drawings, dimensions, tolerances, etc.*	1
4	**Module 4: Design Engineering Concepts**	
4.1	Project-based Learning and Problem-based Learning in Design. *How engineering students can learn design engineering through projects?* *How students can take up problems to learn design engineering?*	1
4.2	Modular Design and Life Cycle Design Approaches. *What is modular approach in design engineering? How it helps?* *How the life cycle design approach influences design decisions?*	1
4.3	Application of Bio-mimicry, Aesthetics and Ergonomics in Design. *How do aesthetics and ergonomics change engineering designs?* *How do the intelligence in nature inspire engineering designs? What are the common examples of bio-mimicry in engineering?*	1
4.4	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design. *How do concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?*	1
4.5	Case Studies: Bio-mimicry based Designs. *Conduct exercises to develop new designs for simple*	1

	products using bio-mimicry and train students to bring out new nature inspired designs.	
5	**Module 5: Expediency, Economics and Environment in Design Engineering**	
5.1	Design for Production, Use, and Sustainability. *How designs are finalized based on the aspects of production methods, life span, reliability and environment?*	1
5.2	Engineering Economics in Design. *How to estimate the cost of a particular design and how will economics influence the engineering designs?*	1
5.3	Design Rights. *What are design rights and how can an engineer put it into practice?*	1
5.4	Ethics in Design. *How do ethics play a decisive role in engineering design?*	1
5.5	Case Studies: Design for Production, Use, and Sustainability. *Conduct exercises using simple products to show how designs change with constraints of production methods, life span requirement, reliability issues and environmental factors.*	1
Second Series Examination		

Code.	Course Name	L	T	P	Hrs	Credit
HUT 200	Professional Ethics	2	0	0	2	2

Preamble: To enable students to create awareness on ethics and human values.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the core values that shape the ethical behaviour of a professional.
CO 2	Adopt a good character and follow an ethical life.
CO 3	Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.
CO 4	Solve moral and ethical problems through exploration and assessment by established experiments.
CO 5	Apply the knowledge of human values and social values to contemporary ethical values and global issues.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1								2			2	
CO 2								2			2	
CO 3								3			2	
CO 4								3			2	
CO 5								3			2	

Assessment Pattern

Bloom's category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	30
Understood	20	20	40
Apply	15	15	30

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Tests (2 Nos)	:	25 marks
Assignments/Quiz	:	15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):
1. Define integrity and point out ethical values.
2. Describe the qualities required to live a peaceful life.
3. Explain the role of engineers in modern society.

Course Outcome 2 (CO2)
1. Derive the codes of ethics.
2. Differentiate consensus and controversy.
3. Discuss in detail about character and confidence.

Course Outcome 3(CO3):
1. Explain the role of professional's ethics in technological development.
2. Distinguish between self interest and conflicts of interest.
3. Review on industrial standards and legal ethics.

Course Outcome 4 (CO4):
1. Illustrate the role of engineers as experimenters.
2. Interpret the terms safety and risk.
3. Show how the occupational crimes are resolved by keeping the rights of employees.

Course Outcome 5 (CO5):
1. Exemplify the engineers as managers.
2. Investigate the causes and effects of acid rain with a case study.
3. Explorate the need of environmental ethics in technological development.

Model Question paper

QP CODE: **Reg No:**_____

PAGES:3 **Name :**_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: HUT 200

Course Name: PROFESSIONAL ETHICS

Max. Marks: 100 **Duration: 3 Hours**

(2019-Scheme)

PART A

(Answer all questions, each question carries 3 marks)

1. Define empathy and honesty.
2. Briefly explain about morals, values and ethics.
3. Interpret the two forms of self-respect.
4. List out the models of professional roles.
5. Indicate the advantages of using standards.
6. Point out the conditions required to define a valid consent?
7. Identify the conflicts of interests with an example?
8. Recall confidentiality.
9. Conclude the features of biometric ethics.
10. Name any three professional societies and their role relevant to engineers.

(10x3 = 30 marks)

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Classify the relationship between ethical values and law?

b) Compare between caring and sharing. (10+4 = 14 marks)

Or

12. a) Exemplify a comprehensive review about integrity and respect for others.

b) Discuss about co-operation and commitment. (8+6 = 14 marks)

MODULE II

13.a) Explain the three main levels of moral developments, deviced by Kohlberg.

b) Differentiate moral codes and optimal codes. (10+4 = 14 marks)

Or

14. a) Extrapolate the duty ethics and right ethics.

b) Discuss in detail the three types of inquiries in engineering ethics (8+6 = 14 marks)

MODULE III

15.**a)** Summarize the following features of morally responsible engineers.

(i) Moral autonomy **(ii)** Accountability

b)Explain the rights of employees (8+6 = 14 marks)

Or

16. a) Explain the reasons for Chernobyl mishap ?

b) Describe the methods to improve collegiality and loyalty. (8+6 = 14 marks)

MODULE IV

17.a) Execute collegiality with respect to commitment, respect and connectedness.

b) Identify conflicts of interests with an example. (8+6 = 14 marks)

Or

18. a) Explain in detail about professional rights and employee rights.

b) Exemplify engineers as managers.

MODULE V

19.**a)** Evaluate the technology transfer and appropriate technology.

b) Explain about computer and internet ethics. (8+6 = 14 marks)

Or

20. a) Investigate the causes and effects of acid rain with a case study.

b) Conclude the features of ecocentric and biocentric ethics. (8+6 = 14 marks)

Syllabus

Module 1 – Human Values.

Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue- Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment- Empathy-Self Confidence -Social Expectations.

Module 2 - Engineering Ethics & Professionalism.

Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy – Kohlberg's theory- Gilligan's theory- Consensus and Controversy-Profession and Professionalism- Models of professional roles-Theories about right action –Self interest-Customs and Religion- Uses of Ethical Theories.

Module 3- Engineering as social Experimentation.

Engineering as Experimentation – Engineers as responsible Experimenters- Codes of Ethics- Plagiarism- A balanced outlook on law - Challenges case study- Bhopal gas tragedy.

Module 4- Responsibilities and Rights.

Collegiality and loyalty – Managing conflict- Respect for authority- Collective bargaining- Confidentiality- Role of confidentiality in moral integrity-Conflicts of interest- Occupational crime- Professional rights- Employee right- IPR Discrimination.

Module 5- Global Ethical Issues.

Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics -Role in Technological Development-Engineers as Managers- Consulting Engineers- Engineers as Expert witnesses and advisors-Moral leadership.

Text Book

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
2. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited ,New Delhi,2006.

Reference Books

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014.
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states,2005.
4. http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics.

Course Contents and Lecture Schedule

SL.No	Topic	No. of Lectures 25
1	**Module 1 – Human Values.**	
1.1	Morals, values and Ethics, Integrity, Academic Integrity,Work Ethics	1
1.2	Service Learning, Civic Virtue, Respect for others, Living peacefully	1
1.3	Caring and Sharing, Honesty, Courage, Co-operation commitment	2
1.4	Empathy, Self Confidence, Social Expectations	1
2	**Module 2- Engineering Ethics & Professionalism.**	
2.1	Senses of Engineering Ethics, Variety of moral issues, Types of inquiry	1
2.2	Moral dilemmas, Moral Autonomy, Kohlberg's theory	1
2.3	Gilligan's theory, Consensus and Controversy,Profession& Professionalism, Models of professional roles, Theories about right action	2
2.4	Self interest-Customs and Religion, Uses of Ethical Theories	1
3	**Module 3- Engineering as social Experimentation.**	
3.1	Engineering as Experimentation, Engineers as responsible Experimenters	1
3.2	Codes of Ethics,Plagiarism, A balanced outlook on law	2
3.3	Challenger case study, Bhopal gas tragedy	2
4	**Module 4- Responsibilities and Rights.**	
4.1	Collegiality and loyalty, Managing conflict, Respect for authority	1
4.2	Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest	2
4.3	Occupational crime, Professional rights, Employee right, IPR Discrimination	2
5	**Module 5- Global Ethical Issues.**	
5.1	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics	2
5.2	Role in Technological Development, Moral leadership	1
5.3	Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	2

CODE		CATEGORY	L	T	P	CREDIT
MCN201	SUSTAINABLE ENGINEERING		2	0	0	NIL

Preamble: Objective of this course is to inculcate in students an awareness of environmental issues and the global initiatives towards attaining sustainability. The student should realize the potential of technology in bringing in sustainable practices.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the relevance and the concept of sustainability and the global initiatives in this direction
CO 2	Explain the different types of environmental pollution problems and their sustainable solutions
CO 3	Discuss the environmental regulations and standards
CO 4	Outline the concepts related to conventional and non-conventional energy
CO 5	Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2	3					2
CO 2						2	3					2
CO 3						2	3					2
CO 4						2	3					2
CO 5						2	3					2

Assessment Pattern

Mark distribution

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Level Assessment Questions

Course Outcome 1 (CO1): Understand the relevance and the concept of sustainability and the global initiatives in this direction

1. Explain with an example a technology that has contributed positively to sustainable development.
2. Write a note on Millennium Development Goals.

Course Outcome 2 (CO2): Explain the different types of environmental pollution problems and their sustainable solutions

1. Explain the 3R concept in solid waste management?
2. Write a note on any one environmental pollution problem and suggest a sustainable solution.
3. In the absence of green house effect the surface temperature of earth would not have been suitable for survival of life on earth. Comment on this statement.

Course Outcome 3(CO3): Discuss the environmental regulations and standards

1. Illustrate Life Cycle Analysis with an example of your choice.
2. "Nature is the most successful designer and the most brilliant engineer that has ever evolved". Discuss.

Course Outcome 4 (CO4): Outline the concepts related to conventional and non-conventional energy

1. Suggest a sustainable system to generate hot water in a residential building in tropical climate.
2. Enumerate the impacts of biomass energy on the environment.

Course Outcome 5 (CO5): Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

1. Suggest suitable measures to make the conveyance facilities used by your institution sustainable.

Model Question paper

Part A

(Answer all questions. Each question carries 3 marks each)

1. Define sustainable development.
2. Write a short note on Millennium Development Goals.
3. Describe carbon credit.
4. Give an account of climate change and its effect on environment.
5. Describe biomimicry? Give two examples.
6. Explain the basic concept of Life Cycle Assessment.
7. Name three renewable energy sources.

8. Mention some of the disadvantages of wind energy.
9. Enlist some of the features of sustainable habitat.
10. Explain green engineering.

Part B

(Answer one question from each module. Each question carries 14 marks)

11. Discuss the evolution of the concept of sustainability. Comment on its relevance in the modern world.

OR

12. Explain Clean Development Mechanism.
13. Explain the common sources of water pollution and its harmful effects.

OR

14. Give an account of solid waste management in cities.
15. Explain the different steps involved in the conduct of Environmental Impact Assessment.

OR

16. Suggest some methods to create public awareness on environmental issues.
17. Comment on the statement, “Almost all energy that man uses comes from the Sun”.

OR

18. Write notes on:
    a. Land degradation due to water logging.
    b. Over exploitation of water.
19. Discuss the elements related to sustainable urbanisation.

OR

20. Discuss any three methods by which you can increase energy efficiency in buildings.

Syllabus

Sustainability- need and concept, technology and sustainable development-Natural resources and their pollution, Carbon credits, Zero waste concept. Life Cycle Analysis, Environmental Impact Assessment studies, Sustainable habitat, Green buildings, green materials, Energy, Conventional and renewable sources, Sustainable urbanization, Industrial Ecology.

Module 1

Sustainability: Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

Module 2

Environmental Pollution: Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection.

Module 3

Environmental management standards: ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.

Module 4

Resources and its utilisation: Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy.

Module 5

Sustainability practices: Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanisation, Sustainable cities, Sustainable transport.

Reference Books

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
3. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
4. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
5. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
6. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
7. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
8. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios Publication

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Sustainability	
1.1	Introduction, concept, evolution of the concept	1
1.2	Social, environmental and economic sustainability concepts	1
1.3	Sustainable development, Nexus between Technology and Sustainable development	1
1.4	Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs)	1
1.5	Clean Development Mechanism (CDM)	1
2	Environmental Pollution	
2.1	Air Pollution and its effects	1
2.2	Water pollution and its sources	1
2.3	Zero waste concept and 3 R concepts in solid waste management	1
2.4	Greenhouse effect, Global warming, Climate change, Ozone layer depletion	1
2.5	Carbon credits, carbon trading and carbon foot print.	1
2.6	Legal provisions for environmental protection.	1
3	Environmental management standards	
3.1	Environmental management standards	1
3.2	ISO 14001:2015 frame work and benefits	1
3.3	Scope and Goal of Life Cycle Analysis (LCA)	1
3.4	Circular economy, Bio-mimicking	1
3.5	Environment Impact Assessment (EIA)	1
3.6	Industrial Ecology, Industrial Symbiosis	1
4	Resources and its utilisation	
4.1	Basic concepts of Conventional and non-conventional energy	1
4.2	General idea about solar energy, Fuel cells	1
4.3	Wind energy, Small hydro plants, bio-fuels	1
4.4	Energy derived from oceans and Geothermal energy	1
5	Sustainability Practices	
5.1	Basic concept of sustainable habitat	1
5.2	Methods for increasing energy efficiency of buildings	1
5.3	Green Engineering	1
5.4	Sustainable Urbanisation, Sustainable cities, Sustainable transport	1

MRL201	ELECTRICAL TECHNOLOGY LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble:

This course aims the students to learn about the introduction, working and testing methods of main basics machines of electrical.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Test and validate different types of dc motors.
CO 2	Test and validate different types of dc generators.
CO 3	Validate and to do different test in transformer.
CO 4	To measure power in a three phase system
CO 5	Test and validate different types of three phase induction motors
CO 6	Measure regulation of a given alternator

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1	-	-	3	2	2	3	2	1	3
CO 2	3	2	1	-	-	3	2	2	3	2	1	3
CO 3	3	2	1	-	-	3	2	2	3	2	1	3
CO 4	3	2	1	-	-	3	2	2	3	2	1	3
CO 5	3	2	1	-	-	3	2	2	3	2	1	3
CO 6	3	2	1	-	-	3	2	2	3	2	1	3

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks
Continuous Assessment : 30 marks
Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks
(b) Implementing the work/Conducting the experiment : 10 Marks
(c) Performance, result and inference (usage of equipments and trouble shooting) : 25 Marks
(d) Viva voce : 20 marks
(e) Record : 5 Marks

General instructions: Mandatorily a minimum of nine experiments should be done among the following given experiments. Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

LIST OF EXPERIMENTS

1. Brake test on DC series motor
2. Brake test on DC shunt motor.
3. Open circuit characteristics of dc shunt generator
4. Load test on dc shunt generator
5. Retardation test on a DC machine.
6. Load test on single phase transformer
7. OC and SC test on single phase transformer
8. Three phase power measurement using two wattmeter method
9. Load test on three phase squirrel cage induction motor
10. Load test on three phase slip ring induction motor
11. No load and block rotor test on three phase slip ring induction motor
12. Regulation of alternator by direct loading
13. Static characteristics of SCR.
14. Static characteristics of MOSFET.
15. Obtain output waveform of single phase bridge rectifier using SCR.

N.B Minimum of TEN experiments from the above list are to be done.

Text books

1. J.B. Gupta , Electrical machines, Katson books.
2. Theraja B. L, A textbook of electrical technology, S. Chand &company, New Delhi, 2008.
3. P.S. Bimbhra, Power Electronics, Khanna Publishers, New Delhi

Reference Books

1. Bimbra P. S., Electrical machinery, 7/e, Khanna publishers, 2011.

2. V.K. Mehta, Rohit Mehta, Principles of Electrical Machines, S Chand Publication

3. M. H. Rashid, Power Electronics Circuits, Devices and Applications, Pearson Education

MRL 203	ANALOG AND DIGITAL ELECTRONICS LAB	CATEGORY	L	T	P	CREDIT
		PCC	-	-	3	2

Preamble: This lab course is intended to impart working knowledge and design skills in analog and digital circuits. It also helps the students to demonstrate various applications in analog and digital circuits.

Prerequisite: ESL130 Electronics Workshop

Course Outcomes: After the completion of the course the student will be able to

CO 1	Set up an experiment to obtain the characteristics of BJT and FET.
CO 2	Acquire skills in designing and testing various applications of analog and digital integrated circuits
CO 3	Analyse and interpret the circuits using the softwares which are available for complex design methodologies.
CO 4	Design and implement analog and digital modules based on specifications.
CO 5	Enhance the ability to function effectively as an individual and in a team to accomplish the given task.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	-	2	1	-	-	3	2	-	2
CO 2	3	3	3	3	2	1	1	1	3	2	2	3
CO 3	2	2	2	3	3	1	1	1	3	2	2	2
CO 4	3	3	2	2	2	1	1	1	3	2	2	2
CO 5	1	2	2	2	2	1	1	3	3	2	2	2

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks
Continuous Assessment : 30 marks
Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks
(b) Implementing the work/Conducting the experiment : 10 Marks
(c) Performance, result and inference (usage of equipments and trouble shooting) : 25 Marks
(d) Viva voce : 20 marks
(e) Record : 5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates

evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Course Assessment Questions

1. For the given JFET, find out the pinch off voltage.
2. Design an inverting amplifier of gain 10.
3. Design a circuit to obtain the following transfer characteristics.

4. Generate a waveform with 50% duty cycle using IC 555.
5. Determine the lock in range and capture range of IC 565.
6. Design a 3 bit synchronous counter.
7. Design a full adder and implement it with universal gates.
8. Design a 4 bitgray to binary code converter.
9. Implement an 8:1 multiplexer.
10. Set up an experiment to learn the working of shift registers.

LIST OF EXPERIMENTS (At least 14 of the following experiments)

Any 5 experiments can be simulated using SPICE, Proetus, Scilab, Verilog or Matlab; any relevant package may be used.

1. Characteristics of CE amplifier.
2. Characteristics of JFET/MOSFET.
3. Design of RC Phase shift oscillator using BJT.
4. Study the characteristics of operational amplifier IC 741.
5. Inverting, non inverting amplifier and voltage follower.
6. Design of Differentiator / Integrator and Schmitt Trigger.
7. Design of Astable/monostable using IC 555.

8. Study the response of active first order LPF and HPF filters.
9. Design of PLL.
10. Study and Verify the truth tables of logic gates and flip flops.
11. Design and implementation of 3 bit full adder and subtractor.
12. Design and implementation of code converters using logic gates
    i. Binary to gray and Gray to Binary Code converter.
    ii. BCD to Excess 3 code and Excess 3 to BCD converter.
13. Design and implement Multiplexer and De-multiplexer using logic gates.
14. Design and implement encoder and decoder using logic gates.
15. Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip- flops.
16. Design and implementation of 3bit synchronous and asynchronous counters
17. Construction and verification of 4bit Mod-10/Mod-12 Ripple counters.

Text Books

1. K A Navas, “Electronics Lab Manual-volume 1”,PHI Learning Private Limited,2015.

Reference Books

1. Franco S., “Design with Operational Amplifiers and Analog Integrated Circuits”, 3/e, Tata McGraw Hill, 2008
2. David A. Bell, “Operational Amplifiers & Linear ICs”, Oxford University Press, 2ndedition, 2010.
3. Donald DGivone, “Digital Principles and Design”, Tata McGraw Hill, 2003.