## MATHEMATICS – 4

### (For Electrical, Electronics and Applied Electronics)

| CODE | COURSE NAME | CATEGORY | L | T | P | CREDIT |
|---|---|---|---|---|---|---|
| MAT 204 | PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS | BASIC SCIENCE COURSE | 3 | 1 | 0 | 4 |

**Preamble:** This course introduces students to the modern theory of probability and statistics, covering important models of random variables and analysis of random processes using appropriate time and frequency domain tools. A brief course in numerical methods familiarises students with some basic numerical techniques for finding roots of equations, evaluating definite integrals solving systems of linear equations and solving ordinary differential equations which are especially useful when analytical solutions are hard to find.

**Prerequisite:** A basic course in one-variable and multi-variable calculus.

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

| CO 1 | Understand the concept, properties and important models of discrete random variables and, using them, analyse suitable random phenomena. |
|---|---|
| CO 2 | Understand the concept, properties and important models of continuous random variables and, using them, analyse suitable random phenomena. |
| CO 3 | Analyse random processes using autocorrelation, power spectrum and Poisson process model as appropriate. |
| CO 4 | Compute roots of equations, evaluate definite integrals and perform interpolation on given numerical data using standard numerical techniques |
| CO 5 | Apply standard numerical techniques for solving systems of equations, fitting curves on given numerical data and solving ordinary differential equations. |

### 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 | 2 | 2 | 2 |  |  |  |  | 2 |  | 1 |
| CO 2 | 3 | 2 | 2 | 2 | 2 |  |  |  |  | 2 |  | 1 |
| CO 3 | 3 | 2 | 2 | 2 | 2 |  |  |  |  | 2 |  | 1 |
| CO 4 | 3 | 2 | 2 | 2 | 2 |  |  |  |  | 2 |  | 1 |
| CO 5 | 3 | 2 | 2 | 2 | 2 |  |  |  |  | 2 |  | 1 |

**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. Let X denote the number that shows up when an unfair die is tossed. Faces 1 to 5 of the die are equally likely, while face 6 is twice as likely as any other. Find the probability distribution, mean and variance of X.

2. An equipment consists of 5 components each of which may fail independently with probability 0.15. If the equipment is able to function properly when at least 3 of the components are operational, what is the probability that it functions properly?

3. X is a binomial random variable $B(n,p)$ with $n = 100$ and $p = 0.1$. How would you approximate it by a Poisson random variable?

4. Three balls are drawn at random without replacement from a box containing 2 white, 3 red and 4 black balls. If X denotes the number of white balls drawn and Y denotes the number of red balls drawn, find the joint probability distribution of (X,Y)

**Course Outcome 2 (CO2)**

1. What can you say about $P(X = a)$ for any real number $a$ when $X$ is (i) a discrete random variable? (ii) a continuous random variable?

2. A string, 1 meter long, is cut into two pieces at a random point between its ends. What is the probability that the length of one piece is at least twice the length of the other?

3. A random variable has a normal distribution with standard deviation 10. If the probability that it will take on a value less than 82.5 is 0.82, what is the probability that it will take on a value more than 58.3?

4. X and Y are independent random variables with X following an exponential distribution with parameter $\mu$ and Y following and exponential distribution with parameter$\lambda$. Find $P(X + Y \leqslant 1)$

## Course Outcome 3(CO3):

1. A random process $X(t)$ is defined by $acos(\omega t + \theta)$where $a$ and $\omega$ are constants and $\theta$ is uniformly distributed in$[0,2\pi]$. Show that $X(t)$ is WSS

2. How are the autocorrelation function and power spectral density of a WSS process are related to each other?

3. Find the power spectral density of the WSS random process $X(t)$, given the autocorrelation function $R_X(\tau) = 9e^{-|\tau|}$

4. A conversation in a wireless ad-hoc network is severely disturbed by interference signals according to a Poisson process of rate $\lambda = 0.01$ per minute. (a) What is the probability that no interference signals occur within the first two minutes of the conversation? (b) Given that the first two minutes are free of disturbing effects, what is the probability that in the next minute precisely 1 interfering signal disturbs the conversation? (c) Given that there was only 1 interfering signal in the first 3 minutes, what is the probability that there would be utmost 2 disturbances in the first 4 minutes?

## Course Outcome 4(CO4):

1. Use Newton-Raphson method to find a real root of the equation
   $f(x) = e^{2x} - x - 6$correct to 4 decimal places.

2. Compare Newton's divided difference method and Lagrange's method of interpolation.

3. Use Newton's forward interpolation formula to compute the approximate values of the function $f$at $x = 0.25$from the following table of values of $x$and $f(x)$

| x | 0 | 0.5 | 1 | 1.5 | 2 |
|---|---|---|---|---|---|
| f(x) | 1.0000 | 1.0513 | 1.1052 | 1.1618 | 1.2214 |

4. Find a polynomial of degree 3 or less the graph of which passes through the points (-1, 3), (0,-4), (1,5) and (2,-6)

**Course Outcome 5 (CO5):**

1. Apply Gauss-Seidel method to solve the following system of equations
$$4x_1 - x_2 - x_3 = 3$$
$$-2x_1 + 6x_2 + x_3 = 9$$
$$-x_1 + x_2 + 7x_3 = -6$$

2. Using the method of least squares fit a straight line of the form $y = ax + b$ to the following set of ordered pairs $(x, y)$ :
   (2,4), (3,5), (5,7), (7,10), (9,15)

3. Write the normal equations for fitting a curve of the form $y = a_0 + a_1 x^2$ to a given set of pairs of data points.

4. Use Runge-Kutta method of fourth order to compute $y(0.25)$ and $y(0.5)$, given the initial value problem
$$y' = x + xy + y, y(0) = 1$$

## Syllabus

**Module 1 (Discrete probability distributions)  9 hours**

**(Text-1: *Relevant topics* from sections-3.1-3.4, 3.6, 5.1)**

Discrete random variables and their probability distributions, Expectation, mean and variance, Binomial distribution, Poisson distribution,  Poisson approximation to the binomial distribution, Discrete bivariate distributions, marginal distributions, Independent random variables, Expectation (multiple random variables)

**Module 2 (Continuous probability distributions)   9 hours**

**(Text-1:*Relevant topics* from sections-4.1-4.4, 3.6, 5.1)**

Continuous random variables and their probability distributions, Expectation, mean and variance, Uniform, exponential and normal distributions,   Continuous bivariate distributions, marginal distributions, Independent random variables, Expectation (multiple random variables), i. i. d random variables and  Central limit theorem (without proof).

**Module 3 (Random Processes)   9 hours**

**(Text-2: *Relevant topics* from sections-8.1-8.5, 8.7, 10.5)**

Random processes and classification, mean and autocorrelation, wide sense stationary (WSS) processes, autocorrelation and power spectral density of WSS processes and their properties, Poisson process-distribution of inter-arrival times, combination of independent Poisson processes(merging) and subdivision (splitting) of  Poisson processes (**results without proof**).

**Module 4 (Numerical methods -I)  9 hours**

**(Text 3- *Relevant topics* from sections 19.1, 19.2, 19.3, 19.5)**

Errors in numerical computation-round-off, truncation and relative error, Solution of equations – Newton-Raphson method and Regula-Falsi method. Interpolation-finite differences, Newton's forward and backward difference method, Newton's divided difference method and Lagrange's method.  Numerical integration-Trapezoidal rule and Simpson's 1/3rd rule (**Proof or derivation of the formulae not required for any of the methods in this module**)

**Module 5 (Numerical methods -II)                                                          9 hours**

**(Text 3- *Relevant topics* from sections 20.3, 20.5, 21.1)**

Solution of linear systems-Gauss-Seidel and Jacobi iteration methods. Curve fitting-method of least squares, fitting straight lines and parabolas.  Solution of ordinary differential equations-Euler and Classical Runge-Kutta method of second and fourth order, Adams-Moulton predictor-correction method (**Proof or derivation of the formulae not required for any of the methods in this module**)

**Text Books**

1. (Text-1) Jay L. Devore, *Probability and Statistics for Engineering and the Sciences*, 8$^{th}$ edition, Cengage, 2012

2. (Text-2) Oliver C. Ibe, *Fundamentals of Applied Probability and Random Processes,* Elsevier, 2005.

3. (Text-3) Erwin Kreyszig, *Advanced Engineering Mathematics*, 10 th Edition, John Wiley & Sons, 2016.

**Reference Books**

1. Hossein Pishro-Nik, *Introduction to Probability, Statistics and Random Processes*, Kappa Research, 2014 ( Also available online at www.probabilitycourse.com )
2. V.Sundarapandian, *Probability, Statistics and Queueing theory*, PHI Learning, 2009
3. Gubner, *Probability and Random Processes for Electrical and Computer Engineers*, Cambridge    University Press,2006.
4. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 36 Edition, 2010.

**Assignments**

Assignments should include specific problems highlighting the applications of the methods introduced in this course in physical sciences and engineering.

**Course Contents and Lecture Schedule**

| No | Topic | No. of Lectures |
|----|-------|-----------------|
| **1** | **Discrete Probability distributions** | **9 hours** |
| 1.1 | Discrete random variables and probability distributions, expected value, mean and variance (discrete) | 3 |
| 1.2 | Binomial distribution-mean, variance, Poisson distribution-mean, variance, Poisson approximation to binomial | 3 |
| 1.3 | Discrete bivariate distributions, marginal distributions, Independence of random variables (discrete), Expected values | 3 |
| **2** | **Continuous Probability distributions** | **9 hours** |
| 2.1 | Continuous random variables and probability distributions, expected value, mean and variance (continuous) | 2 |
| 2.2 | Uniform, exponential and normal distributions, mean and variance of these distributions | 4 |
| 2.3 | Continuous bivariate distributions, marginal distributions, Independent random variables, Expected values, Central limit theorem. | 3 |
| **3** | **Random processes** | **9 hours** |
| 3.1 | Random process -definition and classification, mean , autocorrelation | 2 |
| 3.2 | WSS processes its autocorrelation function and properties | 2 |
| 3.3 | Power spectral density | 2 |
| 3.4 | Poisson process, inter-distribution of arrival time, merging and splitting | 3 |
| **4** | **Numerical methods-I** | **9 hours** |
| 4.1 | Roots of equations- Newton-Raphson, regulafalsi  methods | 2 |
| 4.2 | Interpolation-finite differences, Newton's forward and backward formula, | 3 |
| 4.3 | Newton's divided difference method, Lagrange's method | 2 |
| 4.3 | Numerical integration-trapezoidal rule and Simpson's 1/3-rd rule | 2 |
| **5** | **Numerical methods-II** | **9 hours** |
| 5.1 | Solution of linear systems-Gauss-Siedal method, Jacobi iteration | 2 |

| | | |
|------|---------------------------------------------------------------------------------------------|---|
| | method | |
| 5.2 | Curve-fitting-fitting straight lines and parabolas to pairs of data points using method of least squares | 2 |
| 5.3 | Solution of ODE-Euler and Classical Runge-Kutta methods of second and fourth order | 4 |
| 5.4 | Adams-Moulton predictor-corrector method | 1 |
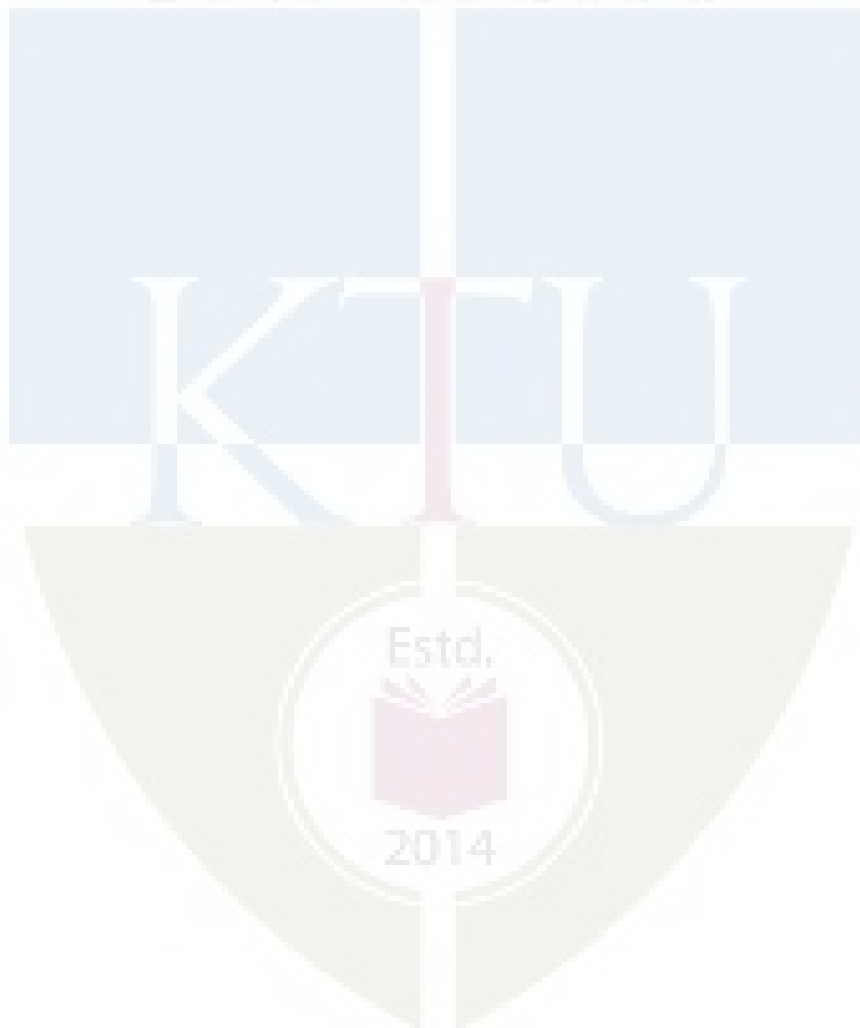
**Model Question Paper**

(**2019 Scheme**)

Reg No: ..................                                        **Total Pages: 3**
Name: .....................

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

FOURTH SEMESTER B.TECH DEGREE EXAMINATION
(Month & year)
**Course Code: MAT 204**

**Course Name: PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS**

(For (i) Electrical and Electronics, (ii) Electronics and Communication, (iii) Applied Electronics and Instrumentation Engineering branches)

Max Marks :100                                        Duration : 3 Hours

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### PART A
**(Answer *all* questions. Each question carries 3 marks)**

1. Suppose $X$ is binomial random variable with parameters $n = 100$ and $p = 0.02$. Find $P(X < 3)$ using Poisson approximation to $X$.   (3)

2. The diameter of circular metallic discs produced by a machine is a random variable with mean 6cm and variance 2cm. Find the mean area of the discs.   (3)

3. Find the mean and variance of the continuous random variable $X$ with probability density function   (3)
$$f(x) = \begin{cases} 2x - 4, & 2 \le x \le 3 \\ 0 & \text{otherwise} \end{cases}$$

4. The random variable $X$ is exponentially distributed with mean 3. Find $P(X > t + 3 | X > t)$ where $t$ is any positive real number.   (3)

5. Give any two examples of a continuous time discrete state random processes.   (3)

6. How will you calculate the mean, variance and total power of a WSS process from its autocorrelation function?   (3)

7. Find all the first and second order forward and backward differences of $y$ for the following set of $(x, y)$ values: $(0.5, 1.13), (0.6, 1.19), (0.7, 1.26), (0.8, 1.34)$   (3)

8. The following table gives the values of a function $f(x)$ for certain values of $x$.   (3)

| $x$ | 0 | 0.25 | 0.50 | 0.75 | 1 |
|---|---|---|---|---|---|
| $f(x)$ | 1 | 0.9412 | 0.8 | 0.64 | 0.5 |

Evaluate $\int_0^1 f(x)dx$ using trapezoidal rule.

9. Explain the principle of least squares for determining a line of best fit to a given data   (3)

10. Given the initial value problem $y' = y + x$,   $y(0) = 0$, find $y(0.1)$ and $y(0.2)$ using Euler method.   (3)

### PART B
**(Answer one question from each module)**

**MODULE 1**

11. (a) The probability mass function of a discrete random variable is $p(x) = kx, x = 1, 2, 3$ where $k$ is a positive constant. Find (i)the value of $k$ (ii) $P(X \leq 2)$ (iii) $E[X]$ and (iv) $\text{var}(1 - X)$. (7)

    (b) Find the mean and variance of a binomial random variable (7)

**OR**

12. (a) Accidents occur at an intersection at a Poisson rate of 2 per day. what is the probability that there would be no accidents on a given day? What is the probability that in January there are at least 3 days (not necessarily consecutive) without any accidents? (7)

    (b) Two fair dice are rolled. Let $X$ denote the number on the first die and $Y = 0$ or 1, according as the first die shows an even number or odd number. Find (i) the joint probability distribution of $X$ and $Y$, (ii) the marginal distributions. (iii) Are $X$ and $Y$ independent ? (7)

**MODULE 2**

13. (a) The IQ of an individual randomly selected from a population is a normal distribution with mean 100 and standard deviation 15. Find the probability that an individual has IQ (i) above 140 (ii) between 120 and 130. (7)

    (b) A continuous random variable $X$ is uniformly distributed with mean 1 and variance 4/3. Find $P(X < 0)$ (7)

**OR**

14. (a) The joint density function of random variables $X$ and $Y$ is given by (7)

$$f(x, y) = \begin{cases} e^{-(x+y)}, & x > 0, \quad y > 0 \\ 0 & \text{otherwise.} \end{cases}$$

    Find $P(X + Y \leq 1)$. Are $X$ and $Y$ independent? Justify.

    (b) The lifetime of a certain type of electric bulb may be considered as an exponential random variable with mean 50 hours. Using central limit theorem, find the approximate probability that 100 of these electric bulbs will provide a total of more than 6000 hours of burning time. (7)

**MODULE 3**

15. (a) A random process $X(t)$ is defined by $X(t) = Y(t) \cos(\omega t + \Theta)$ where $Y(t)$ is a WSS process, $\omega$ is a constant and $\Theta$ is uniformly distributed in $[0, 2\pi]$ and is independent of $Y(t)$. Show that $X(t)$ is WSS (7)

    (b) Find the power spectral density of the random process $X(t) = a \sin(\omega_0 t + \Theta)$, $\omega_0$ constant and $\Theta$ is uniformly distributed in $(0, 2\pi)$ (7)

**OR**

16. Cell-phone calls processed by a certain wireless base station arrive according to a Poisson process with an average of 12 per minute.

    (a) What is the probability that more than three calls arrive in an interval of length 20 seconds? (7)

    (b) What is the probability that more than 3 calls arrive in each of two consecutive intervals of length 20 seconds? (7)

**MODULE 4**

17. (a) Use Newton-Raphson method to find a non-zero solution of $x = 2 \sin x$. Start with $x_0 = 1$     (7)

(b) Using Lagrange's interpolating polynomial estimate $f(1.5)$ for the following data     (7)

| $x$ | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| $y = f(x)$ | 0 | 0.9826 | 0.6299 | 0.5532 |

**OR**

18. (a) Consider the data given in the following table     (7)

| $x$ | 0 | 0.5 | 1 | 1.5 | 2 |
|---|---|---|---|---|---|
| $f(x)$ | 1.0000 | 1.0513 | 1.1052 | 1.1618 | 1.2214 |

Estimate the value of $f(1.80)$ using newton's backward interpolation formula.

(b) Evaluate $\int_0^1 e^{-x^2/2} dx$ using Simpson's one-third rule, dividing the interval [0, 1] into 8 subintervals     (7)

**MODULE 5**

19. (a) Using Gauss-Seidel method, solve the following system of equations     (7)

$$20x + y - 2z = 17$$
$$3x + 20y - z = -18$$
$$2x - 3y + 20z = 25$$

(b) The table below gives the estimated population of a country (in millions) for during 1980-1995     (7)

| year | 1980 | 1985 | 1990 | 1995 |
|---|---|---|---|---|
| population | 227 | 237 | 249 | 262 |

Plot a graph of this data and fit an appropriate curve to the data using the method of least squares. Hence predict the population for the year 2010.

**OR**

20. (a) Use Runge-Kutta method of fourth order to find $y(0.2)$ given the initial value problem     (7)

$$\frac{dy}{dx} = \frac{xy}{1 + x^2}, \quad y(0) = 1$$

Take step-size, $h = 0.1$.

(b) Solve the initial value problem     (7)

$$\frac{dy}{dx} = x + y, \quad y(0) = 0,$$

in the interval $0 \leq x \leq 1$, taking step-size $h = 0.2$. Calculate $y(0.2), y(0.4)$ and $y(0.6)$ using Runge-Kutta second order method, and $y(0.8)$ and $y(1.0)$ using Adam-Moulton predictor-corrector method.

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| CODE | COURSE NAME | CATEGORY | L | T | P | CREDIT |
|---|---|---|---|---|---|---|
| **EET202** | **DC MACHINES AND TRANSFORMERS** | **PCC** | **2** | **2** | **0** | **4** |

**Preamble** : The purpose of the course is to provide the fundamentals of DC generators, DC motors and transformers and giving emphasis to applications in engineering field.

**Prerequisite** : Basics of Electrical Engineering

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

| CO 1 | Acquire knowledge about constructional details of DC machines |
|---|---|
| CO 2 | Describe the performance characteristics of DC generators |
| CO3 | Describe the principle of operation of DC motors and select appropriate motor types for different applications |
| CO 4 | Acquire knowledge in testing of DC machines to assess its performance |
| CO 5 | Describe the constructional details and modes of operation of single phase and three phase transformers |
| CO6 | Analyse the performance of transformers under various conditions |

**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 |  |  | 2 |  |  |  |  |  |  | 3 |
| **CO 2** | 3 | 2 |  |  |  | 2 |  |  |  |  |  | 3 |
| **CO 3** | 3 | 2 | 2 |  |  | 2 |  |  |  |  |  | 3 |
| **CO4** | 3 | 3 |  |  |  | 2 |  |  |  |  |  | 3 |
| **CO5** | 3 |  |  |  |  | 2 |  |  |  |  |  | 3 |
| **CO6** | 3 |  |  |  |  | 2 |  |  |  |  |  | 3 |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tests | | End Semester Examination |
|---|---|---|---|
|  | **1** | **2** |  |
| Remember | 10 | 10 | 20 |
| Understand | 10 | 10 | 30 |
| Apply | 10 | 10 | 30 |
| Analyse | 10 | 10 | 20 |
| Evaluate |  |  |  |
| 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 5 marks for each question. Students should answer all questions. Part B contains five sections;each section shall have 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 10 marks.

**Part A:** 10 Questions x 5 marks=50 marks, **Part B:** 5 Questions x 10 marks =50 marks

**Course Level Assessment Questions**

**CO1:**

1. Describe the functions of individual parts of DC machines.

2. Develop simplex lap and wave windings for different pole and slot configurations.

3. Explain in detail why equaliser rings are required in lap windings.

**CO2:**

1. Describe different types of DC generators.

2. Derive the EMF equation of a DC machine.

3. Draw the open circuit and load characteristics of DC generators.

4. Explain the condition for voltage build up.

5. Explain armature reaction in DC machines and solutions to overcome its effects.

6. Analyse parallel operation of DC generators.

**CO3**:

1. Derive the torque equation of a DC motor.

2. Why starters are used in DC motors?

3. Explain types of speed control in DC motor.

4. Explain regenerative braking in DC motor.

5. What are the losses associated with DC motor?

6. Select suitable type of DC motor for specific applications.

**CO4**:

1. Describe the principle of Swinburn's test for testing of DC motor and perform the calculations.

2. Describe the principle of Hopkinson's test for testing of DC motor.

3. Describe the principle of retardation test for separation of losses in a DC motor.

**CO5**:

1. Derive the EMF equation of single-phase transformer.

2. Derive the condition for maximum efficiency in a transformer.

3. Explain the difference between power transformer and distribution transformer.

4. Explain the current rating and kVA rating of auto transformers.

5. Explain in detail no load and on load tap changing.

6. Draw the various three phase transformer connections.

7. Explain the stabilization by tertiary winding.

**CO6**:

1. Draw the equivalent circuit of single-phase transformer referred to primary side.

2. Explain no load and short circuit test on a single-phase transformer.

3. Explain Sumpner's test on transformers.

4. What are the necessary condition for parallel operation of a single phase and three phase transformers?
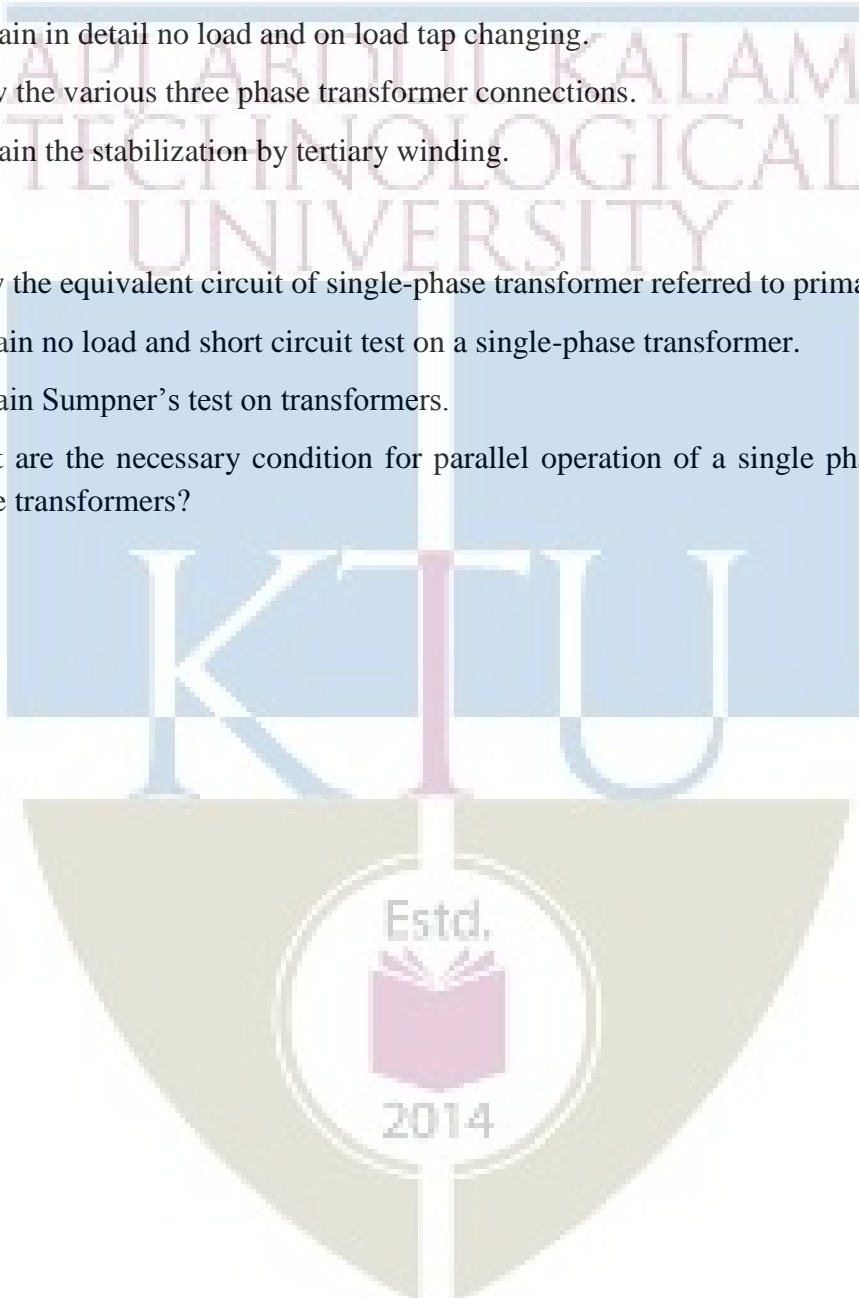
**QP CODE:**

Reg. No:_____
Name:_____

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

**Course Code: EET 202**

**Course Name: DC MACHINES AND TRANSFORMERS**

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

**PART A**

**Answer all questions. Each Question Carries 3 marks**

1. Compare Lap and Wave Windings in DC machines.
2. Explain the need of Dummy Coils in DC machines.
3. What is armature reaction and mention two methods to eliminate it in DC machines.
4. What are the necessary conditions for voltage build up in a DC shunt generator.
5. Explain the significance of Back emf in a DC motor. Write down the voltage equation of a DC shunt motor.
6. Discuss the different types of armature speed control in DC shunt motor.
7. Derive the emf equation for a single phase Transformer.
8. How the rating of a transformer is specified? Justify.
9. Discuss the operation of open delta (V-V) configuration of transformers.
10. Discuss the need and working of on-load tap changers.

**PART B**
**Answer any one full question from each module. Each question carries 14 marks.**
**Module 1**
11. a) Discuss the need of Equalizer rings.                                      **(5)**
    b) Obtain the front and back pitch of a progressive simplex double layer wave
       winding for a 4 pole dc generator with 30 armature conductors.          **(9)**
12. Explain the construction of a DC machine with neat diagram.                **(14)**

**Module 2**
13. Explain different types of DC generator with neat circuit diagram and necessary equations.                                                              **(14)**
14. Two DC shunt generators with induced emfs of 120V and 115V, armature resistance of 0.05Ω and 0.04Ω and field resistances of 20Ω and 25Ω respectively are in parallel supplying a total load of 25kW. Calculate the load shared by each generator?    **(14)**

## Module 3

15. Draw the circuit diagram and explain the experimental procedure to conduct Hopkinson test on DC machine. **(14)**

16. A DC machine is rated at 5kW, 250V, 2000rpm and Ra=1Ω. Driven at 2000rpm, the no load power input to the armature is 1.2A at 250V with field winding (Rsh) = 250Ω, excited by Ish =1A. (i) Estimate efficiency as a generator delivering. (ii) Estimate the efficiency as a motor taking 5kW from supply. **(14)**

## Module 4

17. a) Derive the condition for maximum efficiency and the load current at which max. Efficiency occurs in a single phase transformer. **(8)**

b) Discuss the significance of all day efficiency of transformers. **(6)**

18. A 20kVA, 250/2500V single phase transformer gave the following test results.

OC Test (LV side): 200V, 1.4A, 105W

SC Test (HV side): 120V, 8A, 320W

Draw the equivalent circuit of single phase transformer referred to LV side. **(14)**

## Module 5

19. Explain Auto transformer with neat diagram and Derive an expression to justify thesaving of copper in auto transformer with respect to an ordinary two winding transformer with same rating. **(14)**

20. Explain Dy11 and Yd1 vector groupings of three phase transformers with phasor and winding connection diagrams. **(14)**

**Syllabus**

**Module 1**

Constructional details of dc machines - armature winding- single layer winding, double layer winding- lap and wave, equalizer rings, dummy coils, MMF of a winding, EMF developed, electromagnetic torque - numerical problems.

**Module 2**

DC generator –principle of operation, EMF equation, excitation,armature reaction– demagnetising and cross magnetising ampere turn,compensating windings, interpoles, commutation,OCC, voltage build upand load characteristics, parallel operation. Power flow diagram– numerical problems.

**Module 3**

DC motor –back emf, generation of torque,torque equation,performance characteristics – numerical problems.

Starting of dc motors- starters –3point and 4 point starters(principle only).

Speed control of dc motors - field control, armature control. Braking of dc motors. Power flow diagram – losses and efficiency.Testing of dc motors - Swinburne's test,Hopkinson's test, and retardation test.DC motor applications – numerical problems.

**Module 4**

Single phase transformers –constructional details, principle of operation, EMF equation, ideal transformer,dot convention, magnetising current, transformation ratio, phasor diagram, operation on no load  and on load, equivalent circuit, percentage and per unit impedance, voltage regulation.   Transformer losses and efficiency, condition for maximum efficiency,kVA rating. Testing of transformers– polarity test, open circuit test, short circuit test, Sumpner's test – separation of losses, all day efficiency.Parallel operation of single-phase transformers– numerical problems

**Module 5**

Autotransformer – saving of copper –ratingof autotransformers.

Three phase transformer – construction- difference between power transformer and distributiontransformer –Different connections of 3-phase transformers. Y-Y, Δ-Δ,Y-Δ, Δ-Y, V-V. Vector groupings – Yy0, Dd0, Yd1, Yd11, Dy1, Dy11.Parallel operation of three phase transformers.

Three winding transformer – stabilization by tertiary winding. Tap changing transformers - no load tap changing, on load tap changing, dry type transformers.

**Text Books**

1. Bimbra P. S., Electrical Machinery, 7/e, Khanna Publishers, 2011.

2. Nagrath J. and D. P. Kothari, Theory of AC Machines, Tata McGraw Hill, 2017.

**Reference Books**

1. Fitzgerald A. E., C. Kingsley and S. Umans, Electric Machinery, 6/e, McGraw Hill, 2003.

2. Langsdorf M. N., Theory of Alternating Current Machinery, Tata McGraw Hill, 2001.

3. Deshpande M. V., Electrical Machines, Prentice Hall India, New Delhi, 2011.

4. B. L. Theraja, Electrical Technology Vol II,S.Chand Publications.

5. A. E. Clayton & N. N. Hancock, The Performance and design of Direct Current Machines,CBS Publishers& Distributors, NewDelhi.

**Course Contents and Lecture Schedule**

| Sl. No. | Topic | No. of Hours |
|---|---|---|
| **1** | **Constructional details of dc machines** | **8** |
| 1.1 | Constructional details of DC machines | 2 |
| 1.2 | Armature winding- single layer | 1 |
| 1.3 | Armature winding- double layer-wave and lap, equaliser rings, dummy coils. | 3 |
| 1.4 | MMF of a winding, EMF developed, electromagnetic torque. | 2 |
| **2** | **DC Generator** | **9** |
| 2.1 | DC generators- principle of operation, EMF equation, methods of excitation –separately and self-excited – shunt, series, compound machines.Numerical problems | 3 |
| 2.2 | Armature reaction – effects of armature reaction, demagnetising and cross magnetising ampere-turns, compensating windings,interpoles. Numerical problems. | 3 |
| 2.3 | Load characteristics, losses and efficiency power flow diagram. Parallel operation – applications of dc generators. Numerical problems. | 3 |
| **3** | **DC Motor** | **10** |
| 3.1 | DC motor– principle of operation, back emf, classification– torque equation. Numerical problems. | 2 |

| 3.2 | Starting of DC motors – necessity of starters. Numerical problems. Types of starters – 3 point and 4 point starters(principle only). | 2 |
|---|---|---|
| 3.3 | Speed control – field control, armature control- Numerical problems. Braking of dc motors (Description only) | 2 |
| 3.4 | Losses and efficiency – power flow diagram. Numerical problems | 1 |
| 3.5 | Swinburne's test - Numerical problems. | 1 |
| 3.6 | Hopkinson's test, separation of losses – retardation test. Applications of dc motors. | 2 |
| **4** | **Single phase Transformer** | **10** |
| 4.1 | Transformers – principle of operation, construction, core type and shell type construction. | 1 |
| 4.2 | EMF equation, transformation ratio, ideal transformer,transformer with losses, phasor diagram - no load and on load operation. Numerical problems. | 2 |
| 4.3 | Equivalent circuit, percentage and per unit impedance, voltage regulation. Numerical problems. | 2 |
| 4.4 | Transformer losses and efficiency, Condition for maximum efficiency, all day efficiency – Numerical problems. | 2 |
| 4.5 | Dot convention – polarity test, OC & SC test, Sumpner's test,separation of losses. Numerical problems. | 2 |
| 4.6 | kVA rating of transformers,parallel operation of single phase transformers | 1 |
| **5** | **Autotransformer & Three phase transformer** | 8 |
| 5.1 | Autotransformer – ratings, saving of copper.Numerical problems. | 2 |
| 5.2 | Three phase transformer construction, three phase transformer connections, power transformer and distribution transformer. | 2 |
| 5.3 | Vector groupings Yy0, Dd0, Yd1, Yd11, Dy1, Dy11. | 1 |
| 5.4 | Three winding transformer – tertiary winding.  Percentage and per unit impedance. Parallel operation. | 2 |
| 5.5 | On load and off load tap changers, dry type transformers. | 1 |

| CODE | COURSE NAME | CATEGORY | L | T | P | CREDIT |
|------|-------------|----------|---|---|---|--------|
| **EET204** | **ELECTROMAGNETIC THEORY** | PCC | 3 | 1 | 0 | 4 |

**Preamble** : The purpose of the course is to familiarize the students with the fundamentals of electrostatics, magnetostatics, time-varying fields and electromagnetic waves.

**Prerequisite** : Engineering Mathematics,Engineering Physics

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

| CO 1 | Apply vector analysis and coordinate systems to solve static electric and magneticfield problems. |
|------|-------------|
| CO 2 | Apply Gauss Law, Coulomb's law and Poisson's equation to determine electrostatic field parameters |
| CO 3 | Determine magnetic fields from current distributions by applying Biot-Savart's law and Amperes Circuital law. |
| CO 4 | Apply Maxwell Equations for the solution of timevarying fields |
| CO 5 | Analyse electromagnetic wave propagation in different media. |

**Mapping of course outcomes with programme 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 | | | | | | | | | | |
| CO 2 | 2 | 3 | | | | | | | | | | |
| CO 3 | 2 | 3 | | | | | | | | | | |
| CO 4 | 2 | 3 | | | | | | | | | | |
| CO 5 | 2 | 3 | | | | | | | | | | |

**Assessment Pattern:**

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

*Numerical problems to test the understanding and application of principles to be asked.

**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. Transform the vector $\mathbf{B}= 5\mathbf{a_x}-7\mathbf{a_y}$ to Cylindrical Co-ordinate System at the point P $(r=4, \Phi=120^o, z=2)$.

2. Drawing necessary sketches, obtain the rectangular co-ordinates x,y,z of the point P , in terms of its cylindrical co-ordinates r,Φ,z. Assume the same origin for both co-ordinate systems.

3. Distinguish between Divergence and Gradient. Explain the physical significance of Divergence.

4. State and prove Divergence Theorem.

**Course Outcome 2 (CO2):**

1. A 2µC positive charge is located in vacuum at $P_1(3,-2,4)$ and 5µC negative charge is at $P_2$ (1,-4,-2). Determine: (i) the vector force on the negative charge. (ii) the magnitude of the force on the charge at $P_1$?

2. Apply Gauss's Law to obtain the electric field intensity due to an infinite sheet of charge.

3. Derive an expression for the capacitance of a co-axial cable.

**Course Outcome 3(CO3):**

1. Derive the magnetic field intensity at a point on a line through the centre and perpendicular to the plane of a circular loop of radius 'r' m carrying current 'I' A. The point is at a distance 'h' m from the centre of the loop.

2. State Ampere's Circuital law. Express it in integral and differential forms.

3. State Biot-Savart's Law and express it in vector form.

**Course Outcome 4 (CO4):**

1. Formulate the Maxwell's equation in differential form and integral form for time-varying fields.

2. Derive general wave equations from Maxwell's equations.

3. Explain how Ampere's circuital law can be modified for time-varying fields.

**Course Outcome 5 (CO5):**

1. Define a) intrinsic impedance b) characteristic impedance.

2. Derive wave equations for Uniform plane wave in free space.

3. A 9375 MHz uniform plane wave is propagating in free space. If the amplitude of the electric field intensity is 20 V/m and the material is assumed to be loss less find $\alpha$, $\beta$, $\lambda$, intrinsic impedance, propagation constant and amplitude of magnetic field intensity.
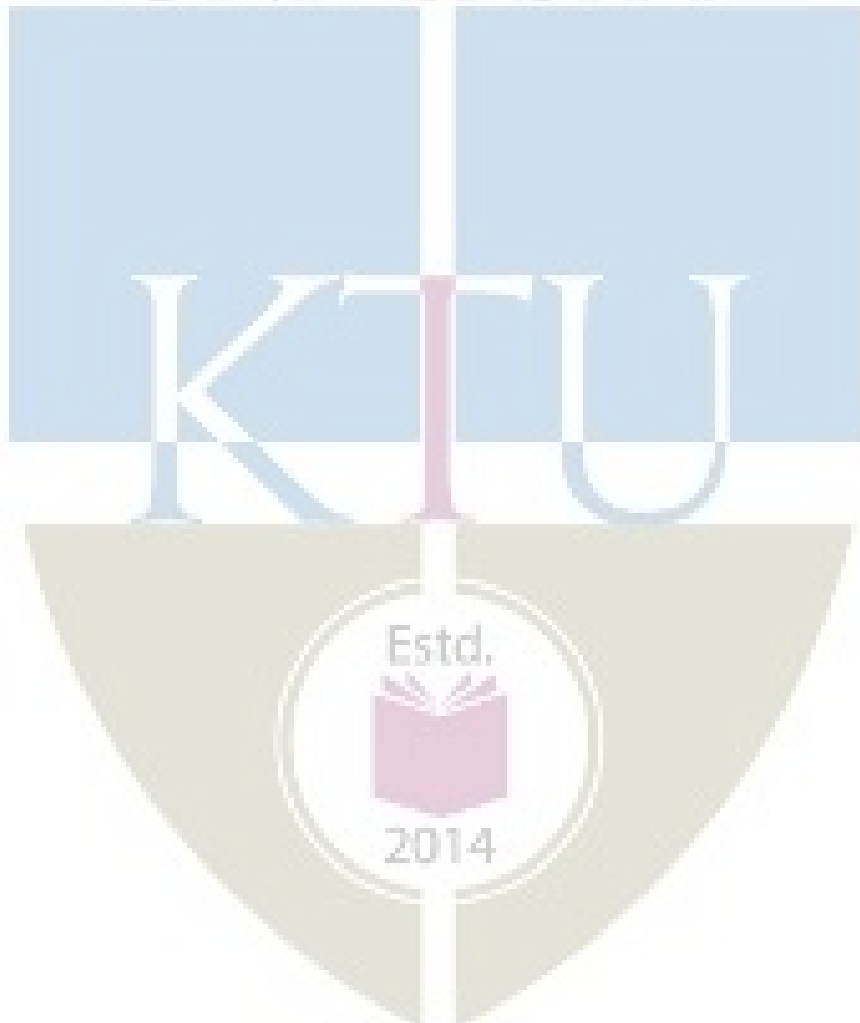
**Model Question paper**

 **QP CODE:**

**Reg. No:**_____

**Name :**_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FOURTH SEMESTER B.TECH DEGREE EXAMINATION,**

**MONTH & YEAR**

**Course Code: EET 204**

**Course Name: ELECTROMAGNETIC THEORY**

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

## PART A

### Answer all Questions. Each question carries 3 Marks

1. State Strokes Theorem and explain**.**
2. What do you understand by Curl of a vector? Explain its physical significance?
3. Define electric dipole. What is the electric field intensity due to an electric dipole?
4. Explain the term electric field intensity.
5. State Biot-Savarts Law.
6. What is conduction current and displacement current?
7. Explain group velocity and phase velocity.
8. Which of Maxwell's equation states that the magnetic field is a non-conservational field in both static and dynamic conditions? Comment.
9. Explain electromagnetic interference.
10. What is SWR?

## PART B

### Answer any one full question from each module. Each question carries 14 Marks

### Module 1

11. (a) Transform vector A= 5 $a\hat{r}$ + 2 sinφ$a\hat{\theta}$ +2 cosθ a$\hat{\phi}$ in spherical to Cartesian coordinate system.                                                                                                          **(6)**

   (b) Evaluate both sides of the Divergence theorem for the region r ≤ 1 and if A= 3r $sin^2\theta$ $cos^2$φ a$\hat{r}$.                                                                                                          **(8)**

12. (a) Derive co-ordinate transformation between Cartesian and Spherical systems.     **(10)**

   (b) Explain the physical significance of divergence of a vector field.               **(4)**

**Module 2**

13. (a) State and Prove Gauss's Law. **(4)**

(b) Four point charges are located at the four corners of the rectangle as shown. Length and breadth of rectangle are 5cm and 2 cm respectively. Find the magnitude and direction of the resultant force on Q1. **(10)**

Q1 = 0.2µC          Q2 = 0.1µC

Q3 = -0.2µC          Q4 = 0.1µC
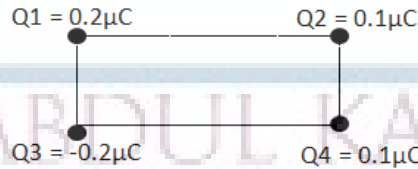
14. (a) Derive the expression of electric field intensity due to infinite line charge having line charge density $\rho$ C/m. **(6)**

(b) Using Gauss's Law derive an expression for the capacitance per unit length between two infinitely long concentric conducting cylinders. The medium between two cylinders is completely filled with air. **(8)**

**Module 3**

15. (a) State the boundary conditions at the boundary of two magnetic media of permeability $\mu 1$ and $\mu 2$. **(10)**

(b) Flux lines are received at an iron-air boundary at$88^0$. If the iron has a relative permeability of 350, determine the angle from the normal with which the flux emerges into air. **(4)**

16. (a) Find the incremental contribution $\Delta H$ to magnetic field intensity at the origin caused by a current element in free space, IdL equal to $3\pi$ a$\hat{z}$nA, located at (3,-4,0). **(8)**

(b) Derive the magnetic field intensity on the axis of a circular loop carrying current. **(6)**

**Module 4**

17. (a) A 10GHz plane wave travelling in free space has an amplitude 15V/m. Find velocity of propagation, wavelength, amplitude of H, characteristic impedance of media, propagation constant. **(10)**

(b) What is skin effect and skin depth? **(4)**

18. (a) Explain about Poynting Theorem. Show that the power flow along a concentric cable is the product of voltage and current using pointing Theorem. **(10)**

(b) What is uniform plane wave? What are its properties? **(4)**

**Module 5**

19. (a) Explain in detail impedance matching of lines. **(10)**

(b) Explain the term propagation constant and phase velocity as applied to transmission lines. **(4)**

20. (a) Derive the basic transmission line equation. **(9)**

(b) What are the different parameters of transmission lines? **(5)**

# Syllabus

**Module 1:**

Introduction to Co-ordinate Systems – Rectangular, Cylindrical and Spherical Co- ordinate Systems – Co-ordinate transformation; Gradient of a Scalar field, Divergence of a Vector field and Curl of a Vector field- their physical interpretation; Divergence Theorem, Stokes' Theorem;

**Module 2:**

Coulomb's Law, Electric field intensity, Field due to a line charge, surface charge distribution. Electric Flux and Flux Density; Gauss's law and its application to determine the field due to an infinite line charge, infinite sheet charge; Electric Potential-Potential Gradient, conservative property of electric field, Equipotential surfaces; Electric Dipole; Capacitance - capacitance of co-axial cable, two wire line; Poisson's and Laplace's equations;

**Module 3:**

Biot-Savart's Law, Magnetic Field intensity due to a finite and infinite wire carrying current; Magnetic field intensity on the axis of a circular and rectangular loop carrying current; Magnetic flux Density; Magnetic Vector Potential; Ampere's circuital law and simple applications; Inductance and mutual inductance. Boundary conditions for electric fields and magnetic fields;

Conduction current and displacement current densities; Continuity equation for current; Maxwell's Equation in Differential and Integral form from Modified form of Ampere's circuital law, Faraday's Law and Gauss's Law.

**Module 4:**

Wave Equations from Maxwell's Equations; Uniform Plane Waves, Wave equations in Phasor form; Propagation of Uniform Plane waves in free space, loss-less and lossy dielectric medium, Uniform Plane waves in good conductor; Skin effect and skin depth, phase velocity and groupvelocity, Intrinsic Impedance, Attenuation constant and Propagation Constant in all medium;Poynting Vector and Poynting Theorem.

**Module 5:**

Transmission line: Waves in transmission line, Line parameters, Transmission line equation & solutions, Propagation constants, Characteristic impedance, Wavelength, Velocity of propagation. Standing Wave Ratio(SWR), impedance matching.Solution of problems. Electromagnetic interference.

**Text Books**

1. Matthew N.O. Sadiku, *Principles of Electromagnetics*, Oxford University Press, 6th Edition.

2 Hayt W. H. and J. A. Buck, *Engineering Electromagnetics*, McGraw-Hill, 8th Edition.

**Reference Books**

1 Joseph A. Edminister, *Electromagnetics, Schaum's Outline Series*, Tata McGraw-Hill, Revised 2nd Edition.

2 John Kraus and Daniel Fleisch, *Electromagnetics with Applications*, McGraw-Hill, 5[th]edition

3 Cheng D K,*Fundamentals of Engineering Electromagnetics*, Addison-Wesley.

4 Guru B. S. and H. R.Hizroglu, *Electromagnetic Field Theory Fundamentals*,PWS Publication Company,Boston, 1998.

5 Gangadhar K. A. and P. M. Ramanathan, *Electromagnetic Field Theory*, Khanna Publishers, 2009

**Course Contents and Lecture Schedule**

| No | Topic | No. of Lectures |
|---|---|---|
| 1 | **Module 1:** | **9** |
| 1.1 | Introduction to coordinate systems – Rectangular, cylindrical and spherical coordinate Systems – Coordinate transformation. Numerical Problems. | 3 |
| 1.2 | Gradient of a scalar field, Divergence of a vector field and curl of a vector field- physical interpretation. Numerical Problems. | 3 |
| 1.3 | Divergence Theorem, Stokes' Theorem.Numerical Problems. | 3 |
| 2 | **Module 2:** | **9** |
| 2.1 | Coulomb's Law, Electric field intensity, Field due to a line charge, surface charge distribution. Numerical Problems. | 2 |
| 2.2 | Electric Flux and Flux Density; Gauss's law and its application to determine the field due to an infinite line charge, Infinite sheet charge. Numerical problems. | 3 |

| 2.3 | Electric Potential-Potential Gradient, conservative property of electric field, Equipotential surfaces. Numerical Problems. | 2 |
|---|---|---|
| 2.4 | Electric Dipole, Capacitance, Poisson's and Laplace's equations.Numerical Problems. | 2 |
| 3 | **Module 3:** | **11** |
| 3.1 | Biot-Savart's Law, Magnetic Field intensity due to a finite and infinite wire carrying current.Magnetic field intensity on the axis of a circular and rectangular loop carrying current.Numerical Problems. | 3 |
| 3.2 | Magnetic flux Density; Magnetic Vector Potential; Ampere's circuital law and simple applications, Numerical Problems. | 3 |
| 3.3 | Boundary conditions for electric fields and magnetic fields. Conduction current and displacement current densities; Continuity equation for current; Electrostatic Energy Density.; Numerical Problems. | 3 |
| 3.5 | Maxwell's Equation in Differential and Integral form from Modified form of Ampere's circuital law, Faraday's Law and Gauss's Law; Numerical Problems. | 2 |
| 4 | **Module 4:** | 8 |
| 4.1 | Wave Equations from Maxwell's Equations; Uniform Plane Waves, Wave equations in Phasor form. Numerical Problems. | 3 |
| 4.2 | Propagation of Uniform Plane waves in free space, loss-less and lossy dielectric medium, Uniform Plane waves in good conductor-properties in different medium.Numerical Problems. | 3 |
| 4.3 | Skin effect and skin depth, Poynting Vector and Poynting Theorem. Numerical Problems. | 2 |
| 5 | **Module 5:** | 8 |
| 5.1 | Transmission line: Waves in transmission line, Line parameters.Numerical Problems. | 3 |
| 5.2 | Transmission line equation &solutions, Physical significance of solutions,Propagation constants, Characteristic impedance, Wavelength, Velocity of propagation.Numerical Problems. | 3 |
| 5.3 | SWR, impedance matching .Solution of problems. Electromagnetic interference Solution of problems. | 2 |

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| CODE | COURSE NAME | CATEGORY | L | T | P | CREDIT |
|---|---|---|---|---|---|---|
| **EET206** | **DIGITAL ELECTRONICS** | PCC | 3 | 1 | 0 | 4 |

**Preamble**          : Nil

**Prerequisite**       : Nil

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

| CO 1 | Identify various number systems, binary codes and formulate digital functions using Boolean algebra. |
|---|---|
| CO 2 | Design and implement combinational logiccircuits. |
| CO 3 | Design and implement sequential logic circuits. |
| CO 4 | Compare the operation of various analog to digital and digital to analog conversion circuits. |
| CO 5 | Explain the basic concepts of programmable logic devices and VHDL. |

**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 | 1 | | | | | | | | | | |
| CO 2 | 3 | 3 | 2 | | | | | | | | | |
| CO 3 | 3 | 3 | 2 | | | | | | | | | |
| CO 4 | 3 | 2 | 1 | | | | | | | | | |
| CO 5 | 3 | 2 | 2 | | 2 | | | | | | | |

**Course Level Assessment Questions**

**Course Outcome 1 (CO1):**

1. Convert one number system to another form.-Binary, decimal, octal and hexadecimal
2. Arithmetic's using of a 2's complement method?
3. Binary and BCD arithmetic's.
4. Reduce the Boolean expression.
5. Develop logiccircuits using Universal gates.
6. Reduce the Boolean expression using Boolean laws.
7. Describe the logic levels used in TTL logic system.

**Course Outcome 2 (CO2):**

1. Convert an SOP form to a POS form and vice-versa?
1. Boolean expression simplification using K map.
2. Design full adder using NAND gates alone.
3. Draw and explain the circuit of carry look ahead adder circuit.
4. Discusshow the look ahead carry adder speed up the addition process?
5. Design of  i)Half adder  ii) Full adder  iii) Full subtractor using gates

6. Differentiate priority encoder andordinaryencoder.
7. Explain the use of the enable input in a decoder?
8. Explain odd parity generator and even parity generator.
9. Differentiate between Multiplexers and De- Multiplexers.
10. Design an 8421 to 2421 BCD code converter and draw its logic diagram.

**Course Outcome 3(CO3):**

1. Explain different types of flip-flops and its application areas.
2. Design various counter circuits.
3. Describe a level triggered flipflopand compare it with an edge triggered flipflop?
4. Discuss master slave flipflop?
5. Design a mod-7 asynchronous counter using J-K flipflop.
6. Distinguish ring counter from Johnson counter.
7. Explain various types of shift register?
8. Differentiate between a counter and a shift register?

**Course Outcome 4 (CO4):**

1. Determine the number of output voltages that can be produced by an 8 bit ADC.
2. Write the advantage of the R-2R ladder DAC over the weighted resistor type DAC?
3. Which one is the fastest ADC and explain why?
4. Compare PLA and PAL?
5. Describe programmable logic array and differentiate it from ROM?

**Course Outcome 5 (CO5):**

1. Differentiate between Moore and Mealy machine?
2. Explain the function of mealy machine
3. Code implementation of  simple  circuits using  Verilog
4. Explain FPGA and state its applications?

**Model Question Paper**

QP Code:                                                                                           Pages: 2

Reg No: _____

Name: _____

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

### Course Code: EET 206
### Course Name: DIGITAL ELECTRONICS

Max. Marks: 100                                                                    Duration: 3 Hours

### PART A
### Answer all Questions. Each question carries 3 Marks

1. Translate the gray code 10110010101 to binary number.

2. Express the decimal number -31 as an 8 bit binary number in sign magnitude form, 1's complement form and 2's complement form.

3. Simplify the Boolean expression $AB + \overline{AC} + A\bar{B}C(AB + C)$.

4. Develop the standard Sum of Products(SOP) for the logic expression $F(A, B, C, D) = AB + \bar{A}B\bar{D} + B\bar{C}D$

5. Differentiate between Multiplexers and De- Multiplexers.

6. Realize a 2-bit comparator.

7. How does a J-K Flip Flop differ from an S-R Flip Flop in its operation?

8. What are PRESET and CLEAR inputs?

9. Draw the schematic of a successive approximation A/D converter.

10. Differentiate PLA and PAL circuits                                          **(10 x 3 = 30)**

### PART B
### Answer any one full question from each module. Each question carries 14 Marks

### Module 1

11. (a) Why is two's - complement method of representing signed integer numbers preferred overones complement in digital circuits? What is range of numbers that can be represented using two's complement with four bits?     **(10)**

    (b) Represent the decimal number $3.248 \times 10^4$ in single precision IEEE binary format **(4)**

12. (a) Explain the working of a TTL NAND gate with the help of internal diagram.     **(10)**

    (b) Compare CMOS and TTL performance.                                          **(4)**

## Module 2

13. (a) Make use of a 4 variable K map and simplify $F(A,B,C,D) = \sum_m$

(1,4,9,10,11,12,14) + d(0,8,13). Realize the function using NAND gates only. **(10)**

(b) Design a half adder circuit and realize using NAND gates only. **(4)**

14. (a) Realize a look-ahead-carry adder. **(8)**

(b) Construct the truth table for a full adder. Reduce it using K map. Implement it using logic gates. **(6)**

## Module 3

15. (a) Explain the even parity method for error detection. **(8)**

(b) Use a 4 x 1 MUX to implement the logic function $F(A,B,C) = \sum_m(1,2,4,7)$. **(6)**

16. (a) What is the purpose of decoder? Explain the functioning of a BCD to Decimal Decoder circuit. **(8)**

(b) Explain the architecture of ALU with the help of a block diagram **(6)**

## Module 4

17. (a) Realize an S-R flip flop using a D flipflop. **(10)**

(b) What is the race around condition of a J-K flip flop? How can it be avoided? **(4)**

18. (a) Design a Synchronous Mod-6 Counter using J-K FFs **(8)**

(b) Draw a parallel in -serial out (PISO) register and explain its working. **(6)**

## Module 5

19. (a) Differentiate between Moore and Mealy machine? Compare them with the help of logic diagrams. **(10)**

(b) What is the advantage of the R-2R ladder DAC over the weighted resistor type DAC?

**(4)**

20. (a) Explain FPGA and state its applications? **(8)**

(b) Design and implement a half adder using Verilog. **(6)**

**Syllabus**

**Module 1**

Number Systems and Codes: Binary, Octal and hexadecimal conversions- ASCII code, Excess -3 code, Gray code, BCD, Error detection codes-Parity method.

Signed numbers- representation, addition and subtraction,Fixed point and floating-point representation.

Logic gates, Universal gates, TTL and CMOS logic families-Internal diagram of TTL NAND gate and CMOS NOR gate. Comparison of CMOS and TTL performance.

**Module 2**

Boolean Laws and theorems, Sum of Products method, Product of Sum method – K map representation and simplification(up to four variables) - Pairs, Quads, Octets, Don't care conditions.

Combinational circuits: Adders -Full adder and half adder, Subtractors- halfsubtractor and fullsubtractor, 4 bit parallel binary adder/subtractor, Carry Look ahead adders.

**Module 3**

Comparators, Parity generators and checkers, Encoders, Decoders, , BCD to seven segment decoder, Code converters, Multiplexers, Demultiplexers, Architecture of Arithmetic Logic Units (Block schematic only).

**Module 4**

Flip-Flops, SR, JK, D and T flip-flops, JK Master Slave Flip-flop, Preset and clear inputs, Conversion of flip-flops.

Registers -SISO, SIPO, PISO, PIPO.

Up/Down Counters: Asynchronous Counters – Modulus of a counter – Mod-N counters Ring counter, Johnson Counter

Synchronous counters,Design of Synchronous counters.

**Module 5**

State Machines: State transition diagram, Moore and Mealy Machines

Digital to Analog converter –Specifications, Weighted resistor type, R-2R Ladder type.Analog to Digital Converter – Specifications, Flash type, Successive approximation type.

Programmable Logic Devices - PAL, PLA, FPGA (Introduction and basic concepts only)
Introduction to Verilog, Implementation of AND, OR, half adder and full adder.
Note: Course assignments may be given in Verilog programming

**Text Books**

1. Floyd T.L, Digital Fundamentals, 10/e, Pearson Education, 2011.
2. C.H.Roth and L.L.Kimney Fundamentals of Logic Design, 7/e, Cengage Learning, 2013.
3. Mano M.M, Logic and Computer Design Fundamentals, 4/e, Pearson Education.
4. A Anand Kumar, Fundamental of Digital Electronics ,Prentice Hall
5. Roy Chaudari ,Linear Integrated Circuits, New Age International Publications
6. S. Salivahanan , Digital Circuits and Design, Oxford University Press

**Reference Books**

1. Donald P. Leach, Albert Paul Malvino and GoutamSaha, Digital Principles and Applications, 8/e, by McGraw Hill.
2. Tocci R.J. and N.S.Widmer, Digital Systems, Principles and Applications, 11/e, Pearson Education.
3. John F. Wakerly, Digital Design: Principles and Practices, 4/e, Pearson, 2005.
4. Taub& Schilling: Digital Integrated Electronics, McGraw Hill, 1997.

**Course Contents and Lecture Schedule**

| No | Topic | No. of Lectures |
|---|---|---|
| **1** | **Number systems and Binary codes10** | |
| 1.1 | Introduction, Binary, Octal and hexadecimal conversions | 2 |
| 1.2 | ASCII code, Excess -3 code, Gray code, BCD. | 1 |
| 1.3 | Error detection codes –Parity Codes. | 1 |
| 1.4 | Signed numbersrepresentation, addition and subtraction | 1 |
| 1.5 | Fixed point and floating-point representation | 2 |
| 1.6 | Logic gates and universal gates | 1 |
| 1.7 | TTL and CMOS logic families-Internal diagram of TTL NAND gate and CMOS NOR gate. Comparison of CMOS and TTL performance. | 2 |
| **2** | **Boolean Algebra and Adders9** | |
| 2.1 | Boolean Laws and theorems. | 1 |
| 2.2 | Standard forms and canonical forms, Sum of Products method, Product of Sums method. | 2 |
| 2.3 | K-map representation and simplification (upto four variables) -Pairs, Quads, Octets, Don't care conditions. Realisation using universal gates. | 2 |
| 2.4 | Adders - Full adder and half adder – Subtractors, half subtractor and full subtractor. | 2 |
| 2.5 | 4-bit parallel binary adder/subtractor. | 1 |
| 2.6 | Carry Look-ahead adders. | 1 |

| 3 | **Combinational Logic Circuits** | **9** |
|---|---|---|
| 3.1 | 2- and 4-bit magnitude comparator. | 2 |
| 3.2 | Parity generators and checkers. | 1 |
| 3.3 | Encoder, Decoder-BCD to decimal and BCD to seven segment decoders. | 2 |
| 3.4 | Realisation of Code converters. | 1 |
| 3.5 | Multiplexers and implementation of functions, Demultiplexers | 2 |
| 3.6 | Architecture of Arithmetic Logic Units (Block schematic only) | 1 |
| **4** | **Sequential circuits10** | |
| 4.1 | Flip-Flops, SR, JK, D and T flip-flops, JK Master Slave Flip-flop, Preset and clear inputs | 2 |
| 4.2 | Conversion of flip-flops. | 2 |
| 4.3 | Registers -SISO, SIPO, PISO, PIPO. | 1 |
| 4.4 | Up/Down Counters: Asynchronous Counters – Modulus of a counter – Mod-N counters. | 2 |
| 4.5 | Ring counter, Johnson Counter. | 1 |
| 4.6 | Design of Synchronous counters | 2 |
| **5** | **State Machines, D/A and A/D converters and PLDs7** | |
| 5.1 | State Machines: State transition diagram, Moore and Mealy Machines | 1 |
| 5.2 | Digital to Analog converter – R-2R ladder, weighted resistors. | 1 |
| 5.3 | Analog to Digital Converter - Flash ADC, Successive approximation. | 1 |
| 5.4 | Programmable Logic Devices - PAL, PLA-function implementation - FPGA (Introduction and basic concepts only). | 2 |
| 5.5 | Introduction to VHDL, Implementation of AND, OR, half adder and full adder. | 2 |

| 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 | **<u>Module 5: Expediency, Economics and Environment in Design Engineering</u>** | |
| 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 | PO1 0 | PO1 1 | PO1 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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. Explore 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 | COURSE NAME | CATEGORY | L | T | P | CREDIT |
|------|-------------|----------|---|---|---|--------|
| MCN202 | CONSTITUTION OF INDIA | | 2 | 0 | 0 | NIL |

**Preamble:**

The study of their own country constitution and studying the importance environment as well as understanding their own human rights help the students to concentrate on their day to day discipline. It also gives the knowledge and strength to face the society and people.

**Prerequisite:** Nil

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

| CO 1 | Explain the background of the present constitution of India and features. |
|------|--------------------------------------------------------------------------|
| CO 2 | Utilize the fundamental rights and duties. |
| CO 3 | Understand the working of the union executive, parliament and judiciary. |
| CO 4 | Understand the working of the state executive, legislature and judiciary. |
| CO 5 | Utilize the special provisions and statutory institutions. |
| CO 6 | Show national and patriotic spirit as responsible citizens of the country |

**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 | 2 | 2 | | 2 | | |
| CO 2 | | | | | | 3 | 3 | 3 | | 3 | | |
| CO 3 | | | | | | 3 | 2 | 3 | | 3 | | |
| CO 4 | | | | | | 3 | 2 | 3 | | 3 | | |
| CO 5 | | | | | | 3 | 2 | 3 | | 3 | | |
| CO 6 | | | | | | 3 | 3 | 3 | | 2 | | |

**Assessment Pattern**

| 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 | | | |

**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 Discuss the historical background of the Indian constitution.

2 Explain the salient features of the Indian constitution.

3 Discuss the importance of preamble in the implementation of constitution.

**Course Outcome 2 (CO2)**

1 What are fundamental rights ? Examine each of them.

2 Examine the scope of freedom of speech and expression underlying the constitution.

3 The thumb impression of an accused is taken by the police against his will. He contends

 that this is a violation of his rights under Art 20(3) of the constitution. Decide.

**Course Outcome 3(CO3):**

 1 Explain the powers of the President to suspend the fundamental rights during emergency.

 2 Explain the salient features of appeal by special leave.

 3. List the constitutional powers of President.

**Course Outcome 4 (CO4):**

1 Discuss the constitutional powers of Governor.

2 Examine the writ jurisdiction of High court.

3 Discuss the qualification and disqualification of membership of state legislature.

**Course Outcome 5 (CO5):**

1 Discuss the duties and powers of comptroller of auditor general.

2 Discuss the proclamation of emergency.

3 A state levies tax on motor vehicles used in the state, for the purpose of maintaining roads

   in the state.  X challenges the levy of the tax on the ground that it violates the freedom of

   interstate commerce guaranteed under Art 301. Decide.

**Course Outcome 6 (CO6):**

1 Explain the advantages of citizenship.

2 List the important principles contained in the directive principles of state policy.

3 Discuss the various aspects contained in the preamble of the constitution

**Model Question paper**

**PART A**

(Answer all questions. Each question carries 3 marks)

1 Define and explain the term constitution.

2 Explain the need and importance of Preamble.

3 What is directive principle of state policy?

4 Define the State.

5 List the functions of Attorney general of India.

6 Explain the review power of Supreme court.

7 List the qualifications of Governor.

8 Explain the term and removal of Judges in High court.

9 Explain the powers of public service commission.

10 List three types of emergency under Indian constitution.

(10X3=30marks)

**PART B**

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

**Module 1**

11 Discuss the various methods of acquiring Indian citizenship.

12 Examine the salient features of the Indian constitution.

**Module 2**

13 A high court passes a judgement against X. X desires to file a writ petition in the supreme

court under Art32, on the ground that the judgement violates his fundamental rights.

Advise him whether he can do so.

14 What is meant by directive principles of State policy? List the directives.

**Module3**

15 Describe the procedure of election and removal of the President of India.

16 Supreme court may in its discretion grant special leave to appeal. Examine the situation.

**Module 4**

17 Discuss the powers of Governor.

18 X filed a writ petition under Art 226 which was dismissed. Subsequently, he filed a writ

petition under Art 32 of the constitution, seeking the same remedy. The Government

argued that the writ petition should be dismissed, on the ground of res judicata. Decide.

**Module 5**

19 Examine the scope of the financial relations between the union and the states.

20 Discuss the effects of proclamation of emergency.

(14X5=70marks)

**Syllabus**

**Module 1** Definition, historical back ground, features, preamble, territory, citizenship.

**Module 2** State, fundamental rights, directive principles, duties.

**Module 3** The machinery of the union government.

**Module 4** Government machinery in the states

**Module 5** The federal system, Statutory Institutions, miscellaneous provisions.

**Text Books**

1 D D Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi, 24e, 2019

2 PM Bhakshi, The constitution of India, Universal Law, 14e, 2017

**Reference Books**

1 Ministry of law and justice, The constitution of India, Govt of India, New Delhi, 2019.

2 JN Pandey, The constitutional law of India, Central Law agency, Allahabad, 51e, 2019

3 MV Pylee, India's Constitution, S Chand and company, New Delhi, 16e, 2016

**Course Contents and Lecture Schedule**

| No | Topic | No. of Lectures |
|---|---|---|
| 1 | **Module 1** | |
| 1.1 | Definition of constitution, historical back ground, salient features of the constitution. | 1 |
| 1.2 | Preamble of the constitution, union and its territory. | 1 |
| 1.3 | Meaning of citizenship, types, termination of citizenship. | 2 |
| 2 | **Module 2** | |
| 2.1 | Definition of state, fundamental rights, general nature, classification, right to equality ,right to freedom , right against exploitation | 2 |

| 2.2 | Right to freedom of religion, cultural and educational rights, right to constitutional remedies. Protection in respect of conviction for offences. | 2 |
|------|---|---|
| 2.3 | Directive principles of state policy, classification of directives, fundamental duties. | 2 |
| 3 | **Module 3** | |
| 3.1 | The Union executive, the President, the vice President, the council of ministers, the Prime minister, Attorney-General, functions. | 2 |
| 3.2 | The parliament, composition, Rajya sabha, Lok sabha, qualification and disqualification of membership, functions of parliament. | 2 |
| 3.3 | Union judiciary, the supreme court, jurisdiction, appeal by special leave. | 1 |
| 4 | **Module 4** | |
| 4.1 | The State executive, the Governor, the council of ministers, the Chief minister, advocate general, union Territories. | 2 |
| 4.2 | The State Legislature, composition, qualification and disqualification of membership, functions. | 2 |
| 4.3 | The state judiciary, the high court, jurisdiction, writs jurisdiction. | 1 |
| 5 | **Module 5** | |
| 5.1 | Relations between the Union and the States, legislative relation, administrative relation, financial Relations, Inter State council, finance commission. | 1 |
| 5.2 | Emergency provision, freedom of trade commerce and inter course, comptroller and auditor general of India, public Services, public service commission, administrative Tribunals. | 2 |
| 5.3 | Official language, elections, special provisions relating to certain classes, amendment of the Constitution. | 2 |

| CODE | COURSE NAME | CATEGORY | L | T | P | CREDIT |
|--------|------------------------------|----------|---|---|---|--------|
| **EEL202** | **ELECTRICAL MACHINES LAB I** | **PCC** | **0** | **0** | **3** | **2** |

**Preamble** : The purpose of this lab is to provide practical experience in operation and testing of DC machines and transformers.

**Note** : A minimum of **TWELVE** experiments are mandatory out of the fifteen listed.

**Prerequisite :**

1. Fundamentals of Electrical Engineering
2. D.C Machines and Transformers (Theory)

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

| CO 1 | Analyse the performance of DC motors and DC generators by performing load test. |
|------|---------------------------------------------------------------------------------|
| CO 2 | Sketch the Open Circuit Characteristics of a self excited DC shunt generator and check conditions of voltage build up by performing suitable experiment. |
| CO 3 | Develop equivalent circuit and predetermine their regulation and efficiency by performing OC & SC tests on transformer. |
| CO 4 | Analyse the efficiency and regulation of the transformer by performing load test. |
| CO 5 | Analyse the efficiency of a DC machine when working as motor and generator by conducting suitable test. |
| CO 6 | Examine the efficiency by performing Sumpner's test on two similar transformers. |

**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 | - | - | - | - | 3 | 2 | - | 3 |
| **CO 2** | 3 | 3 | 2 | 2 | - | - | - | - | 3 | 2 | - | 3 |
| **CO 3** | 3 | 3 | 2 | 2 | - | - | - | - | 3 | 2 | - | 3 |
| **CO 4** | 3 | 3 | 2 | 2 | - | - | - | - | 3 | 2 | - | 3 |
| **CO 5** | 3 | 3 | 2 | 2 | - | - | - | - | 3 | 2 | - | 3 |
| **CO 6** | 3 | 3 | 2 | 2 | - | - | - | - | 3 | 2 | - | 3 |

**Assessment Pattern**

**Marks 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 equipment and troubleshooting) | 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 Laboratory Record. The external examiner shall endorse the record.

**Course Level Assessment Questions**

**Course Outcome 1 (CO1):**

1) Conduct a brake test on the given DC series motor and plot its electrical characteristics and speed versus armature current curve.

2) Plot the load characteristics of the given differentially compounded DC generator by conducting suitable experiments.

3) Plot the electrical and mechanical characteristics of the given DC shunt motor by conducting suitable experiments.

**Course Outcome 2 (CO2):**

1) Predetermine the OCC of the given D.C shunt generator when running at 80% rated speed and also find the critical resistance at rated speed.

2) Plot the OCC of the D.C shunt generator at its rated speed and obtain its critical resistance and critical speed. Also obtain the additional resistance required in the field circuit for generating rated voltage on no load.

**Course Outcome 3(CO3):**

1) Predetermine the per phase equivalent circuit of the 3 phase transformer referred to low voltage side by conduction suitable experiments. Also compute its KVA corresponding to maximum efficiency.

2) Predetermine the maximum efficiency of the given single phase transformer at upf by conducting suitable experiment. Also compute its full load regulation at upf.

**Course Outcome 4 (CO4):**

1) Plot the regulation and efficiency curves of the given 1-phase transformer by conducting a suitable experiment.

2) Plot the regulation and efficiency curves of the given 3-phase transformer by conducting a suitable experiment.

**Course Outcome 5 (CO5):**

1) Conduct a suitable test on the given DC shunt machine and predetermine the efficiency curve of the machine both as motor and as generator

**Course Outcome 6 (CO6):**

1) Conduct a suitable test on two similar 1-phase transformers and predetermine its efficiency at full load and 0.8 pf lagging.

2) Conduct a suitable test on two similar 1-phase transformers and predetermine its efficiency at half load and UPF.

## LIST OF EXPERIMENTS

### PART A- DC MACHINES

1. **Open Circuit Characteristics of a DC Shunt Generator**

   *Objectives:*

   a) Predetermine the OCC at different speeds
   b) Determine the critical field resistance
   c) Obtain maximum voltage built up with given shunt field
   d) Obtain critical speed for a given shunt field resistance

2. **Load Test on a DC Shunt Generator**

   *Objectives:*

   a) Determine the external & internal characteristics of the given DC Shunt Generator

3. **Brake Test on a DC Shunt Motor**

   *Objectives:*

   Plot the following characteristics
   a) Performance characteristics
   b) Electrical characteristics
   c) Mechanical characteristics.

4. **Brake Test on a DC Series Motor**

   *Objectives:*

   Plot the following characteristics
   a) Performance characteristics
   b) Electrical characteristics
   c) Mechanical characteristics.

5. **Load Characteristics of a DC Compound Generator**

   *Objectives:*

   a) To plot the load characteristics of the given DC Compound generator when cumulatively compounded.
   b) To plot the load characteristics of the given DC Compound generator when differentially compounded

6. **Swinburne's Test on a DC Shunt Machine**

   *Objectives:*

   a) To predetermine the efficiency of a D.C. shunt machine when the machine operates as a motor and as a generator for various load conditions
   b) To plot the efficiency curves of the given DC machine.

7. **Hopkinson's test on a pair of DC machines**

   *Objectives:*

   Determination of the efficiency of the given dc shunt machine working as a motor and generator under various load conditions.

8. **Retardation test on a DC machine**

   *Objectives:*

   a) Separation of hysteresis, eddy current, friction &windage losses
   b) Find the moment of inertia of the rotating system

9. **Separation of losses in a DC shunt motor**

   *Objectives:*

   a) Separation of hysteresis, eddy current, friction &windage losses
   b) Plot the losses vs speed curves

## PART B - TRANSFORMERS

10. **OC & SC Tests on a Single Phase Transformer**

    *Objectives:*

    a) To pre-determine the regulation and efficiency of the given single phase transformer at different loads and power factors
    b) To obtain the equivalent circuit of the given transformer
    c) To plot regulation vs power factor curves
    d) To determine the power factors at which regulation is zero

11. **DirectLoad Test on a Single Phase Transformer**
    *Objectives:*

    a) To determine the efficiency of the given transformer at unity power factor at different loads
    b) To determine the regulation of the given transformer at unity power factor at different loads
    c) To plot the efficiency vs output and regulation vs output curves

**12. Separation of Constant losses of a Single Phase Transformer**

*Objectives:*

a) To separate hysteresis and eddy current losses of a single phase transformer, keeping V/f constant.

b) To plot losses vs. frequency curves, by separating the hysteresis and eddy current losses at normal voltage and different frequencies.

**13. Sumpner's Test**

*Objectives:*

a) To predetermine efficiency at different loads and power factors

b) To predetermine regulation at different loads and power factors

c) To determine the equivalent circuit

**14. Parallel Operation of two dissimilar Single Phase Transformers**

*Objectives:*

a) To determine the load sharing of each transformer by their equivalent impedances.

b) To verify the load sharing by actual measurement.

**15. OC & SC Tests on a Three Phase Transformer**

*Objectives:*

a) To predetermine the efficiency at different load conditions and power factors.

b) To predetermine the regulation at different power factors.

c) To develop the per phase equivalent circuit.

**Reference Books**

1. Bimbra P. S., Electrical Machinery, 7/e, Khanna Publishers, 2011.

2. Theraja B. L., A Textbook of Electrical Technology, S. Chand & Company, New Delhi,

| CODE EEL204 | DIGITAL ELECTRONICS LAB | CATEGORY | L | T | P | CREDIT |
|---|---|---|---|---|---|---|
| | | PCC | 0 | 0 | 3 | 2 |

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

| CO 1 | Formulate digital functionsusing Boolean Algebra and verify experimentally. |
|---|---|
| CO 2 | Design and implement combinational logic circuits. |
| CO 3 | Design and implement sequential logic circuits. |
| CO 4 | Design and fabricate a digital circuit using the knowledge acquired from the laboratory. |

**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 | 1 | 1 | 3 | 3 | | | 2 | 3 | 3 | | 1 |
| CO 2 | 3 | 3 | 3 | 3 | 3 | | | 2 | 3 | 3 | | 1 |
| CO 3 | 3 | 3 | 3 | 3 | 3 | | | 2 | 3 | 3 | | 1 |
| CO 4 | 3 | 2 | 1 | 3 | 2 | | | 2 | 3 | 3 | 2 | 3 |

## LIST OF EXPERIMENTS

**Pre-lab assignment** :Familiarisation of Logic Gates, Identification of typical logic ICs, Interpreting IC datasheets.

1. Verification & Realisation of De Morgan's theorem.
2. Realisation of SOP & POS functions after K-map reduction.
3. Half adder & Full adder using gates.
4. 4-bit adder/subtractor & BCD adder using IC 7483.
5. Realisation of 2-bit comparator using gates and study of four-bit comparator IC 7485.
6. BCD to decimal decoder and BCD to 7-segment decoder & display.
7. Study of multiplexer IC and realization of combinational circuits using multiplexers.
8. Realization of RS, T, D & JK flip flops using gates.
9. Study of flip flop ICs (7474 & 7476).
10. Realisation of ripple up and down counters and modulo-N counter using flip-flops.
11. Study of counter ICs (7490, 7493).
12. Design of synchronous up, down & modulo-N counters.
13. Realization of 4-bit serial IN serial OUT registers using flip flops.
14. Study of shift register IC 7495, ring counter and Johnsons counter.
15. VHDL implementation of full adder, 4 bit magnitude comparator

**Course Project** : Students have to do a mandatory course project (group size not more than 4 students) using digital ICs or Programmable Logic Devices (CPLD/FPGA) to realise a functional digital circuit. A maximum of 5 marks shall be awarded for this project (to be evaluated along with the final internal test).

**Example of course projects :**

1. Realisation of a real-time digital clock with display.
2. Digital Alarms
3. ALU (May be implemented in FPGA)
4. Digital Security Monitoring System
5. Traffic Control

**Assessment Pattern :**

**Mark distribution :**

| Total Marks | CIE | ESE | ESE Duration |
|-------------|-----|-----|--------------|
| 150 | 75 | 75 | 2.5 hours |

**Continuous Internal Evaluation (CIE) Pattern:**

| Attendance | Regular Lab work | InternalTest | CourseProject | Total |
|------------|------------------|--------------|---------------|-------|
| 15 | 30 | 25 | 5 | 75 |

**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 equipment and troubleshooting) : 25 Marks
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**Reference Books:**

1. Floyd T.L, Digital Fundamentals, 10/e, Pearson Education, 2011.
2. C.H.Roth and L.L.Kimney Fundamentals of Logic Design, 7/e, Cengage Learning, 2013.