2022

PHYSICS — HONOURS

(Syllabus : 2019-20)

Paper : SEC-B-1

[Arduino]

Full Marks : 20

Time : 30 minutes

Answer *any ten* questions each carrying 2 marks.

1. The programme written in Arduino IDE is known as

    (a) Module

    (b) Link

    (c) Script

    (d) Sketch

2. In the following programme what will be the output in serial monitor if 3.7 volt is applied to pin A0?

    ```
    void setup( ) {
    serial.begin(9600);
    }
    void loop( ) {
    int sensorValue = analogRead(A0)
    serial.println(sensorValue);
    }
    ```

    (a) 353

    (b) 512

    (c) 613

    (d) 757

3. What will be the output of the following code?

```
#define X 10;
void setup( ) {
    X = 0;
Serial.begin(9600);
Serial.print(X);
}
void loop( ) {
//Do nothing
}
```

   (a) 0

   (b) 10

   (c) X

   (d) Error

4. What are the two modes that the pinMode( ) command sets for a particular pin?

   (a) HIGH and LOW

   (b) DIGITAL and ANALOG

   (c) READ and WRITE

   (d) INPUT and OUTPUT

5. What type of signal does the analogWrite( ) function output?

   (a) Analog signal of constant amplitude

   (b) Pulse width modulated signal

   (c) Amplitude modulated signal

   (d) Frequency modulated signal.

6. What is the correct order of execution process of an Arduino code?

   (a) Editor → Preprocessor → Compiler

   (b) Editor → Compiler → Preprocessor

   (c) Preprocessor → Compiler → Editor

   (d) Preprocessor → Editor → Compiler

7. What is the resolution of analogRead( )?

   (a) 4.9 mV

   (b) 4 mV

   (c) 5 mV

   (d) 7 mV

8. Number of digital pins in Arduino UNO are

   (a) 11

   (b) 12

   (c) 15

   (d) 13

9. The basic function of ADC is to

   (a) Convert Analog to Digital signal

   (b) Convert Digital to Analog signal

   (c) Convert Digital pin to Analog

   (d) Convert Analog pin to Digital

10. The clock speed of the Arduino UNO board is

   (a) 32 MHz

   (b) 16 MHz

   (c) 1 MHz

   (d) 5 MHz

11. TX pin represents _____ in the Arduino Board.

   (a) Transmitter

   (b) Receiver

   (c) Reset

   (d) Export

12. IC LM35 is a IC of

   (a) Temperature controller

   (b) Temperature sensor

   (c) Voltage controller

   (d) Current controller

(2019-20 Syllabus)

Paper : SEC-B-2

[Electrical Circuites and Networks Skills]

Full Marks : 80

Time : 3 hrs.

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer *question no.* **1** and **2** and *any four* from the rest.

1. Answer *any ten* quesitons :   2×10

    (a) Slip rings are usually made of

        (i) Copper

        (ii) Carbon

        (iii) Phosphor bronze

        (iv) Aluminium.

    (b) An induction wattmeter can be used for

        (i) both D.C. and A.C.

        (ii) D.C. only

        (iii) A.C. only

        (iv) None of these.

    (c) Why shell type 3-phase transformer is used in large power transforming application?

        (i) More height and less height flexibility

        (ii) Can be made with less height

        (iii) Can be made with more height

        (iv) Due to other reasons.

    (d) Why is the transformer core laminated?

    (e) What happens when a DC motor is connected across an AC supply?

    (f) State the applications of series DC motor.

    (g) Why and where Megger is used?

    (h) What is the function of insulator in transmission line?

(i) What is the relationship between the line current and phase current in delta-connected system?

(j) Why is inter connection of a 3-phase system necessary?

(k) What is the effect of number of poles on speed of motor?

(l) What is meant by relay settings?

(m) How does a circuit breaker different from switch?

Answer *any four* questions.

2. (a) What does voltage spike mean? What is the function of a circuit breaker? State two appliations of relay. 1+2+2

(b) With neat sketches briefly describe the working principle of a transformer. 5

(c) Write two advantages of induction type wattmeter over dynamo type wattmeter? Draw the torque-slip curve of a 3-phase induction motor for different values of rotor resistances. 2+3

(d) (i) What is the function of poles in DC generator?

(ii) An 8-pole lap-wound DC generator has 960 conductors and a flux/pole of 40 mWb. Calculate the generated emf when it runs at 400 rpm. (2+3)

(e) (i) Distinguish between induction motor and synchronous motor.

(ii) Write difference between single phase and 3-phase transformer. 3+2

(f) (i) What are the fundamental differences between D.C. motor and D.C. generator.

(ii) A 3-phase, 4-pole induction motor is connected to 50 Hz supply. Calculate the speed of the rotor when the slip is 0.02. 2+3

(g) (i) Explain why single phase induction motor is not self-starting one?

(ii) Define slip-frequency. 3+2

3. (a) With neat sketches explain the principle of operation of 3-phase induction motor.

(b) A 4-pole, 3-phase induction motor operates from a 50 Hz supply. Calculate (i) the speed at which the magentic field is rotating, and (ii) the frequency of rotor current and the rotor speed when the slip is 4%. 5+(2+1+2)

4. (a) Draw and exaplin torque-speed characteristic of a D.C. motor. (seperately excited).

(b) What is the function of armature winding in a D.C. generator.

(c) For a D.C. shunt motor draw the three important characteristic curves. 5+2+3

Please Turn Over

5. (a) Starting from the 1st principle develop the equivalent circuit of a three phase induction motor.

   (b) Explain the double field revolving theory for operation of single phase induction motor.

   5+5

6. (a) With a neat circuit diagram explain how 3 phase power can be measured by 2 wattmeter method.

   (b) What is sub-station? Classify briefly according to their construction. Draw the line diagram of a commonly used sub-station.

   4+(1+2+3)

7. (a) What are the two types of constructions generally used in transformers. Compare the two types of these transformers.

   (b) What is the Cu loss that take place in a transformers. What are the factors that affects the Cu loss.

   (c) The primary winding of a 50 Hz single phase trasnformer has 500 turns and is fed from a 6 kilovolt supply. If the secondary winding has 25 turns, find the peak flux value in the core.

   (d) What is meant by shunt and multiplier?

   (1+3)+2+2+2

8. Write short notes on *any two* :

   5×2

   (a) Protective relay

   (b) SF$_6$ circuit breaker

   (c) Working principle of Megger.

(Syllabus : 2018-19)

Paper : SEC-B-1

[Computer Algebra System and Figure Drawing Skill]

Full Marks : 80

Time : 3 hrs.

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words
as far as practicable.

Answer *question nos.* **1** and **2** and *any four* questions from the rest.

1. Answer *any ten* questions :   2×10

    (a) What is the role of 'TYPE' in YACAS?

    (b) Expand $((x + 2.5)^2)$.

    (c) How do you assign a value against a variable in YACAS?

    (d) Write down the o/p of the expression cForm(a + b*b*d + e).

    (e) What would be the o/p of the YACAS command : Tail ({a, b, c, d})?

    (f) Explain the YACAS command $N(^3/_7)$.

    (g) Can you compute the divergence of vector field in YACAS?

    (h) What is computer Algebra System?

    (i) What is the utility of the YACAS command Pretty Form(expr)?

    (j) What would be the output of the YACAS command : Divisors(6)?

    (k) What can you do with Xfig?

    (l) How is $\cos^{-1}x$ represented in YACAS?

2. Answer *any four* questions :   5×4

    (a) How do you declare a function in YACAS? Explain with example.

    (b) Given the differential equation : $y'' + 6y = 0$

    Write down the YACAS command for solving the given equation. Mention the requisite command

    to get the value of the solution at $x = \frac{\pi}{2}$.

Please Turn Over

(c) What is the utility of spline curves in computer graphics?

(d) Explain the 'while' loop in YACAS with an example program.

(e) Explain how to evaluate LCM and GCD in YACAS.

(f) What are the basic differences between Bitmap and Vector drawing programs?

3. Perform the indefinite integration $\int e^x x^2 dx$ using YACAS. Mention the commands explicitly.   10

4. Evaluate the Taylor expansion of the function $f(x) = \cos(x)$ up to 5 terms. Evaluate the function for $x = \dfrac{1}{2}$. Mention clearly the YACAS command and output.   10

5. Write down the YACAS program to find the sum of the first 5 natural numbers.   10

6. Given : $\vec{A} = \hat{i} + \hat{j} + \hat{k}$ 10

$\vec{B} = 4\hat{i} + 7\hat{j} + 9\hat{k}$

Write down the YACAS command for evaluating $\vec{A} \times \vec{B}$, $\vec{A} \cdot \vec{B}$.

7. Construct the random polynomial of 4th order. Set the coefficient of the polynomial between −5 to +5 (choose accordingly). Evaluate the polynomial at $x = 0.1$, 0.2, 0.3. Mention clearly the YACAS commands.   10

8. Create a list containing 7 natural numbers.   10

(a) Create another list from this list in reverse order.

(b) Join the two lists into a single list.

(c) Partition this list containing two items in each list.

———————

(2018-19 Syllabus)

Paper : SEC-B-2

[Renewable Energy and Energy Harvesting]

Full Marks : 80

Time : 3 hrs.

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Answer **question nos.** 1 and 2 and **any four** questions from the rest.

1. Answer **any ten** questions :   2×10

   (a) What do you understand by cogeneration?

   (b) Name a few sites where geothermal energy is harnessed.

   (c) What is Extraterrestrial Radiation and Terrestrial Radiation?

   (d) Define the terms Flood tide, Ebb tide and Tidal range.

   (e) What are the challenges in effective harvesting of solar energy?

   (f) Name two advantages and disadvantages of biomass energy.

   (g) What is osmotic power?

   (h) What is hydro-thermal resource?

   (i) Name two materials which show piezoelectric effect.

   (j) Write down the fundamental energy conversion principle related to the hydropower generation.

   (k) Name the principal devices of energy storage.

   (l) What are the disadvantages of using wind energy?

2. Answer **any four** questions :

   (a) What is OTEC? Discuss the main advantages and disadvantages of OTEC system.   2+3

   (b) What do you mean by vertical windmills? Explain its working principle briefly with a neat sketch.
                                                                                                   2+3

   (c) Discuss the structure and working principle of a solar cell.   2+3

   (d) What is biomass? State the principle of energy harvesting using biomass.   2+3

Please Turn Over

(10)

(e) Write down the working principle of a solar cooker. What are the disadvantages of using the solar cooker? 3+2

(f) Discuss the process of carbon capture and its main storage processes. 3+2

3. (a) What is a fuel cell? Describe the principle of working of a fuel cell with reference to $H_2 - O_2$ cell.

(b) What are the main components of fuel cell? List some of the applications of fuel cells.
$(2+3)+(3+2)$

4. (a) What is a nuclear chain reaction? Explain how electricity is generated from a nuclear reactor.

(b) Compare the energy released from a fission and a fusion process.

(c) Can fission and fusion work together? Why is fusion safer than fission? $(2+3)+2+(1+2)$

5. (a) What are the essential elements of the hydroelectric power plant? What are the merits and demerits of hydro power stations?

(b) What is piezoelectricity? What is the importance of piezoelectricity on society? $(2+3)+(2+3)$

6. (a) What are the limitations of constructing dams across rivers?

(b) What are the main components of fuel cell? List some of applications of fuel cells.

(c) What is the caloric value of a fuel? $3+(3+2)+2$

7. (a) What are the major advantages of the fuel cells?

(b) Derive an expression for efficiency of a fuel cell. What is the maximum efficiency of a fuel cell?

(c) Describe any two different forms of energy which can be extracted from sea. $2+(3+1)+4$

8. (a) What are the different means of storing solar energy?

(b) Explain active and passive solar systems with examples.

(c) What is solar pond? Describe the operation of a solar pond. $2+(2+2)+(1+3)$