C 83799-B (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2020

EE 19 101—BASICS OF ELECTRICAL ENGINEERING

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*
Each question carries 5 marks.

1. Briefly explain open circuit voltage and short circuit current.
2. A resistor of 5 Ω is connected in series with a parallel combination of 6 Ω and 3 Ω. Find the supply current taken from a 35 V d.c. source.
3. Explain the method of Star / Delta transformation.
4. Define MMF, Field strength, flux density and reluctance.
5. State and explain Lenz's law. Give its application.
6. Distinguish between statically induced e.m.f. and dynamically induced e.m.f.
7. Obtain the effective value of a.c. of a half rectified sine wave.
8. Define Form factor of a sine wave. What is its value ?
9. A sinusoidal e.m.f. of frequency 50 Hz has r.m.s. value of 250 V. Calculate its instantaneous value 0.0025 second after the instant at which the e.m.f. is zero and then decreasing.
10. Draw the schematic representation of generator and motor. Explain.
11. A four pole d.c. generator has 384 lap connected conductors. If the flux per pole is 25 mWb, find the induced voltage when the machine is running at 1500 r.p.m.
12. What do you mean by back e.m.f. or counter e.m.f. of D.C. motors ?
13. Distinguish between squirrel cage induction motor and slip ring induction motor.
14. Explain briefly solar power generation.
15. What are the advantages and disadvantages of Tidal energy ?

(10 × 5 = 50 marks)

Turn over

Part B

Answer section (a) **or** *section (b) of each question.*
Each question carries 10 *marks.*

16. (a) (i) State and explain Kirchhoff's law.

(ii) Two resistance of 10 Ω and 5 Ω are connected in series. The series combination is connected across a 30 V d.c. supply. Find the power dissipated in each resistance and the total power drawn from the supply.

Or

(b) Three resistances R, 2R and 3R are connected in delta form. Determine the resistance for equivalent star connection.

17. (a) List and explain the comparison between electric and magnetic circuit.

Or

(b) The magnetic flux density inside a toroid having 3200 turns with inner and outer radii 10 cm and 11 cm is 2.5 T, for a current 0.8 A. Calculate the relative permeability of the core.

18. (a) A resistance of 10 Ω is connected in series with an inductive reactance of 30 Ω. The series combination is connected across a 230 V, 50 Hz supply. Determine the active power, the reactive power and the power factor.

Or

(b) Derive the relation between the phase and line values of voltage and current of a three-phase star connected system.

19. (a) Name the various parts of a D.C. motor and explain its construction and working.

Or

(b) List and explain the properties of an ideal transformer. With a neat diagram explain the principle, construction and operation of an ideal transformer.

20. (a) Sketch the layout of a typical hydroelectric power project. Also mark the positions of reservoir, intake, penstock, surge tank, turbine and generator.

Or

(b) Draw the line diagram of thermal power station and explain its working. Giving its details.

(5 × 10 = 50 marks)

C 83799-A (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2020

EC 19 101—BASICS OF ELECTRONICS ENGINEERING

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*
Each question carries 5 *marks.*

1. Explain the construction of fixed and variable inductors. Give two applications of each.
2. Discuss the differences in electrical action of inductors and capacitors.
3. Discuss the principle and working of relays and contactors.
4. Distinguish between intrinsic and extrinsic semiconductors.
5. Explain the principle of working of Zener diode.
6. Explain the input and output characteristic of common emitter configuration.
7. Explain the role of filter in a power supply. List the advantages of Full wave rectifier compared to half wave rectifier.
8. Realize two input X-OR gate using only NAND gates.
9. A 10 V Zener diode along with a series resistance is connected across a 40 V supply. Calculate the minimum value of resistance required if the maximum Zener current is 50 mA.
10. In a phase-shift oscillator, the three RC networks are identical with R = 100 Ω and C = 0.05 μF. Find the frequency of oscillation.
11. Define current gain, voltage gain, and power gain of a CE amplifier.
12. Explain the concept of feedback with a neat diagram.
13. Explain the principle of AM demodulation with a neat circuit diagram.
14. Compare AM and FM.
15. Give the basic principle of cellular communication.

(10 × 5 = 50 marks)

Turn over

Part B

Answer section (a) **or** *section (b) of each question.*
Each question carries 10 *marks.*

16. (a) List and explain the different passive components used in electronic industry.

Or

(b) Explain the construction and use of different types of capacitors.

17. (a) Explain with a neat sketch the principle and operation of Photo diode. What are its advantages? Mention its applications.

Or

(b) Explain the principle and operation of solar cell. Discuss the importance of material used for its construction.

18. (a) With help of a block diagram explain the parts of a D.C. power supply and discuss the function of each block.

Or

(b) What is a voltage regulator ? With a circuit diagram explain the principle and working of Zener voltage regulator. Draw the characteristics of Zener diode. What is SMPS ?

19. (a) Explain the working principle of oscillators. Elaborate in detail with circuit diagram the principle and working of phase-shift oscillator.

Or

(b) List and explain the properties of ideal operational amplifier. Discuss the importance of inverting and non-inverting amplifier.

20. (a) Define Modulation index in FM. With help of block diagram explain FM radio receiver.

Or

(b) Draw the block diagram of optical communication. With a neat sketch explain light transmission through fiber. What are the advantages of optical communication ?

(5 × 10 = 50 marks)

C 83799 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2020

CE 19 101—BASICS OF CIVIL ENGINEERING

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*
Each question carries 5 *marks.*

1. Explain briefly NBC.
2. List out the structural components of a residential building.
3. Distinguish between geotechnical and environmental engineering.
4. List out the points to be consider while considering the position and number of doors and windows in a building.
5. Write short note on site plan of a building.
6. Define plot area, plinth area, floor area and carpet area.
7. Explain the principle of chain surveying.
8. Distinguish between Plans and Maps.
9. List the various points to be considered in selecting stations for surveying.
10. What are the different types of cement ?
11. List the properties of good sand.
12. What is meant by seasoning of timber ? Distinguish between natural and artificial seasoning.
13. Distinguish between Flemish bond and English bond in brick masonry.
14. Explain the structural and functional features of roads.
15. With neat sketches explain different types of stone masonry.

(10 × 5 = 50 marks)

Part B

Answer any **one** *full section from each question.*
Each question carries 10 *marks.*

16. (a) Describe in detail the contribution of civil engineering to the welfare of the society.

Or

(b) What are the steps Involved in the selection of site for building ?

17. (a) Assume a suitable scale and draw the plan and elevation of a simple residential building.

Or

(b) Define orientation of a building. Explain the various aspects of orientation.

18. (a) Write short notes on the following :

(a) Total station ;

(b) Global positioning system.

Or

(b) Explain in detail the principle of theodelite surveying.

19. (a) What are the different types of cement ? Explain the properties and uses ?

Or

(b) What are the different types of steel ?

20. (a) List the points to be considered during stone masonry construction.

Or

(b) With neat sketch explain different types of foundations and requirements for good foundation ?

(5 × 10 = 50 marks)

C 83798 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2020

ME 19 101—BASICS OF MECHANICAL ENGINEERING

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*

Each question carries 5 *marks.*

1. Draw the p-V and T-S diagram for Otto cycle.
2. What do you mean by reversible cycle? Give example.
3. The entropy of the universe tends to be maximum. Comment.
4. Differentiate between 2 stroke and 4 stroke engine.
5. What way CRDI different from conventional solid injection system ? What are the advantages of CRDI ?
6. What are the advantages of gear drive over other drives ?
7. What is the function of Draft tube in reaction turbine ?
8. Define COP. Explain the function of refrigerants in refrigeration.
9. Differentiate between hydraulic turbine and pump.
10. What is the function of moderator in nuclear power plant?
11. What are the applications of solar energy ?
12. What are advantages and disadvantages of nuclear power plant ?
13. What are the various mechanical properties of engineering materials ?
14. Explain counter boring and counter sinking operations in drilling.
15. What are the main elements of NC machine ? What is the additional feature in CNC ?

(10 × 5 = 50 marks)

Part B

Answer any **one** *full section from each question.*
Each question carries 10 *marks.*

16. (a) 5 m^3 of gas at 8 bar and 180°C is heated keeping the pressure same throughout till the volume is doubled. Find the heat added, external work done and the change in internal energy during the process. Take c_p = 1.005 kJ/kg.K, c_v = 0.718 kJ/kg.K.

Or

(b) A constant volume chamber of 0.3m^3 capacity contains 2 kg. of a gas at 5° C. Heat is transferred to the gas until the temperature is 100° C. Find the work done, heat transferred, and the change in internal energy, enthalpy and the entropy. Take c_p = 1.968 kJ/kg.K and c_v = 1.507 kJ/kg.K.

17. (a) With help of neat sketch explain 4 stroke diesel engine.

Or

(b) What is meant by gear train ? Explain different types of gear train.

18. (a) Explain the working principle of reciprocating pump.

Or

(b) What is the principle of working of vapour absorption refrigeration system ?

19. (a) Explain the working principle of Thermal power plant with the help of neat sketch.

Or

(b) Explain the various types of non renewable energy sources.

20. (a) What are the various forging operations ? Explain briefly each of them.

Or

(b) What are the various operations that can be performed in a drilling machine ? Explain any four of them.

(5 × 10 = 50 marks)

C 83797 (Pages : 4) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2020

EM 19 100—ENGINEERING MECHANICS

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*
Each question carries 5 *marks.*

1. State the major difference between basic and derived units with valid examples. Quantify the force offered by the weight of 1 kg. of mass in static condition.
2. Explain the concept of static indeterminacy using a simple example.
3. Comment on the various basic laws of mechanics.
4. With the help of a neat diagram briefly define the cone of friction.
5. What are the laws of dry friction ?
6. Define angle of repose with a simple example.
7. What is the basic difference between centroid and centre of gravity. Provide suitable justifications.
8. Define parallel and perpendicular axis theorems.
9. Explain the analytical method for determining the centroid of composite areas.
10. Define the major differences between static and dynamic systems. Site real world examples for each.
11. Using mathematical equations, relate the rectangular co-ordinate system with cylindrical co-ordinate system for a curvilinear motion.
12. What is rectilinear motion? How is it different from that of a curvilinear motion?
13. What is the condition for a mechanical system under equilibrium to undergo vibration ?
14. Define forced and free vibration highlighting real life problems to justify each.
15. What are the basic elements of a vibrating system ?

(10 × 5 = 50 marks)

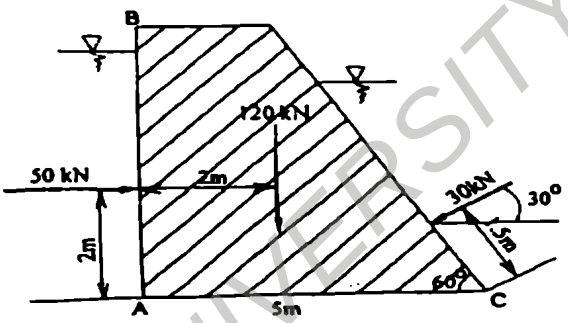
Part B

Answer on full section from each question.
Each question carries 10 marks.

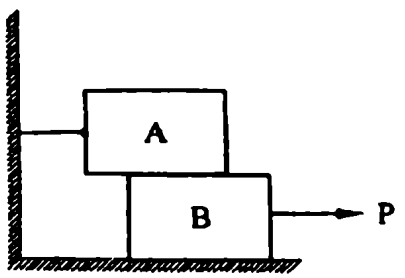
16. (a) Find the resultant and equilibrant of coplanar concurrent force systems. Use a detailed figure to define the force system.

Or

(b) A dam is subjected to three forces, 50 kN force on the upstream vertical face AB, 30 kN force on the downstream inclined face and its own weight 120 kN. Determine the single equivalent force and locate its point of intersection with the base AC, assuming all the forces to lie in the same plane as shown in figure.

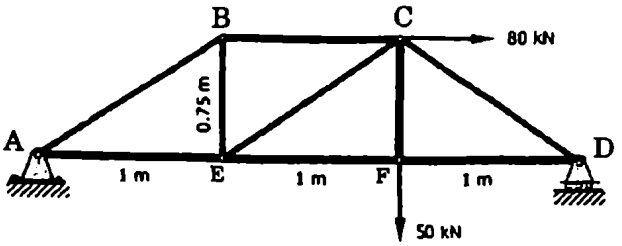


17. (a) Two blocks A and B of weights equivalent to 200 N and 300 N respectively. Find the force required to move block B. Assume the coefficient of friction for all surfaces to be 0.3.

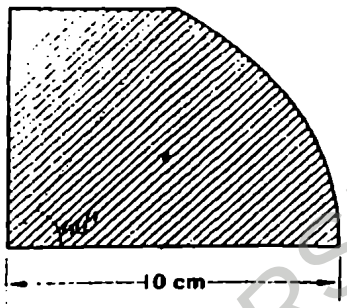


Or

(b) Find the force acting in all the members of the truss as shown in the figure using method of joints.



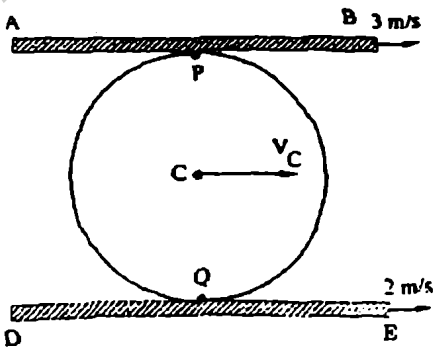
18. (a) Locate the centroid of the area as shown in figure.



Or

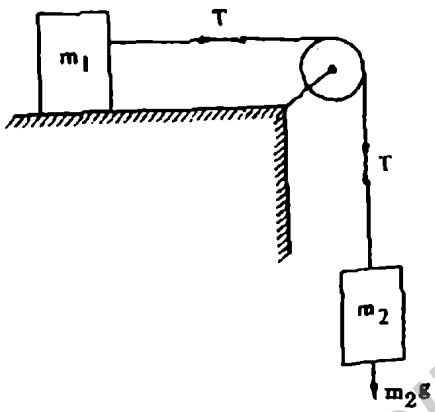
(b) Determine the moment of inertia of a circular of a circular lamina about its centroidal axes.

19. (a) A cylindrical roller is in contact at its top and bottom, with two conveyor belts AB and DE as shown in figure. If the belts run at uniform speeds of 3 m/s and 2 m/s respectively, find the linear velocity and the angular velocity of the roller when, (i) the velocities are in the same direction and (ii) the direction of velocities are opposite. Consider the diameter of the roller to be 40 a.m.



Or

(b) A mass of 60 kg. lies on a smooth horizontal table. It is connected to a fine string passing over a smooth guide pulley on the edge of the table to a mass 50 kg. hanging freely. Find the tension in the string and the acceleration of the system.



20. (a) A body moving with SHM, has an amplitude of 1 m. and the period of oscillation is 2 seconds. Find the velocity and acceleration of the body at time $t = 0.4$ seconds, when time is measured from : (i) The mean position ; and (ii) The extreme position.

Or

(b) A particle moving with SHM has an amplitude of 4.5 m. and period of oscillation is 3.5 seconds. Find the time required by the particle to pass two points which are at a distance of 3.5 m. and 1.5 m. from the centre and on the same side of mean position.

(5 × 10 = 50 marks)

C 83796 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2020

GS 19 100—ENGINEERING GRAPHICS

Time : Three Hours Maximum : 100 Marks

Answer **three** *questions from Part A and any* **two** *questions from Part B.*
All questions carry equal marks.

Part A

1. (a) A line AB measures 100 mm. The projectors through its V.T. and the end A are 40 mm apart. The end A is 30 mm above H.P. and 20 mm in front of V.P. The V.T is 10 mm below H P. Draw the projection of the line and determine H.T. and inclination with H.P. and V.P.

Or

(b) A square lamina ABCD with 40 mm sides has its corner A in the H.P. Its diagonal AC is inclined at 45° to the H.P. while the diagonal BD is parallel to the H.P. and inclined at 30°to the V.P. Draw its projection.

2. (a) A Hexagonal pyramid, having a base of 30 mm side and a 60 mm long axis, has an edge of its base on the ground and the axis is inclined at 30° to the H.P. The edge of the base on which it rests is inclined at 45° to the V.P. Draw its projection.

Or

(b) A cone with 60 mm base diameter and 70 mm long axis, rests on its base on HP. It is cut by an A.I.P. passing through the midpoint of the axis such that the true shape of the section is an ellipse of largest major axis. Draw the projection of the truncated cone and the true shape of the section.

3. (a) A square hole with a 45 mm side is cut centrally into a sector with a 135° included angle and 80 mm radius such that one of the diagonals of the hole is on the central radial line of the sector. Draw the projection of the cone obtained by wrapping the sector.

Or

(b) A triangular prism of base side 45 mm and height 60 mm is placed centrally on the top circular face of the plate of diameter 80 mm and axis 30 mm. The triangular prism is resting on its base with one base edge parallel to V.P. and near to it. The axis of both solids is perpendicular to H. P. Draw the isometric projection of this combination of solids.

(3 × 20 = 60 marks)

Turn over

Part B

Answer any **two** *questions.*

4. (a) Draw the perspective view of a square prism having base with a 30 mm side and 60 mm long axis, resting on its rectangular face on G.P. behind P.P with its axis is inclined at 30° with P.P. such that the centre of the nearest base face in the P.P. The station point is 30 mm in front of the PP, 5 mm to the right of the midpoint of the axis and 50 mm above GP.

   (b) Draw neat sketch of Lewis foundation bolt having a diameter 30 mm.

   (c) A cube with 45 mm long edges rests on H.P. with vertical faces equally inclined to the V.P. It is cut by a section plane perpendicular to the V.P. so that the true shape of the section is a regular hexagon. Draw the sectional top view and true shape of the section. Also determine the inclination of the section plane with the H.P.

(2 × 20 = 40 marks)

C 83795 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2020

CH 19 100—ENGINEERING CHEMISTRY

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*
Each question carries 5 *marks.*

1. What are ion-exchange resins ? Give examples for cation and anion exchange resins.
2. Discuss cationic polymerization mechanism in detail.
3. What are conducting polymers ? Explain the mechanism of conduction of polyaniline.
4. What are the different types of greases ? How are they made ?
5. 0.83 g of a solid fuel on burning in a bomb calorimeter made the temperature of 3500 g of water to rise from 26.5°C to 29.2°C. If the fuel contains 0.7 % hydrogen, calculate the gross and net calorific value. Water equivalent of calorimeter = 385 g. Latent heat of steam = 587 Cal/gm.
6. Define octane number and cetane number. What is their significance ?
7. How fullerenes are obtained ? What are their special properties and uses ?
8. Discuss any *two* principles of green chemistry.
9. Give the properties and applications of carbon nanotubes.
10. Calculate the single electrode potential of zinc electrode at 27°C in a solution of Zn^{2+} = 0.15 M. If E° Zn/Zn^{2+} = 0.76 V.
11. What are the characteristics of fuel cells ?
12. What is an electrochemical series ? What are its uses ?
13. Explain dry corrosion phenomenon.
14. Explain cementation process.
15. Write a short note on Galvanic series.

(10 × 5 = 50 marks)

Turn over

Part B

Answer **one** *full question from each section.*
Each question carries 10 *marks.*

16. (a) Give an account of purification of Muncipal water.

Or

(b) Explain the term glass transition temperature and various factors that affect Tg.

17. (a) What are lubricants ? Give the functions of a lubricant. Explain their classification based on their physical state with suitable examples.

Or

(b) What is reforming ? Explain with examples and reforming reactions. How does reforming increase octane number ?

18. (a) Write hydrolysis and reduction method of synthesis of nanomaterials.

Or

(b) Write short note on green solvents.

19. (a) What is standard hydrogen electrode ? How is it used to measure the standard electrode Potential ? Write the electrode reactions when it acts as an anode and cathode.

Or

(b) Explain Ni-Cd battery. What are its advantages and disadvantages ?

20. (a) Discuss the factors which influence corrosion.

Or

(b) Give an account of inorganic metallic coatings.

(5 × 10 = 50 marks)

C 83794 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2020

PH 19 100—ENGINEERING PHYSICS

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*
Each question carries 5 *marks.*

1. Explain the principle and working of interference filter.
2. Fringes of equal thickness are observed in a thin glass wedge of refractive index 1.52.The spacing of the fringes is 1 mm and the wavelength of light used is 580 nm. Calculate the angle of the wedge.
3. Compare prism spectra and grating spectra.
4. Define expectation value in quantum mechanics. Explain its importance.
5. Calculate the quantum number associated with a marble of mass 10 gram trapped to move in a one dimensional box of width 20 cm with speed 1 m/s.
6. Discuss the results of various statistics.
7. The absorption co-efficient of open window is one. Justify the statement.
8. The area of interior surface of an auditorium is 3340 m^2. Its reverberation time is 1.5 seconds. If average absorption coefficient of interior surface is 0.4 Sabine, find the volume of auditorium.
9. List the different properties of ultrasonic.
10. Briefly explain phase modulated sensors.
11. A fibre cable has an acceptance angle of 30° and a core of refraction of 1.4. Calculate the refractive index of the cladding.
12. With block diagram explain intensity modulated sensor.
13. Explain population inversion and metastable level in a laser.
14. Discuss how population inversion achieved in a ruby laser ?
15. Give a qualitative account of BCS theory.

(10 × 5 = 50 marks)

Turn over

Part B

Answer section (a) **or** *section (b) of each question.*
Each question carries 10 marks.

16. (a) Describe with necessary theory the experiment to determine the diameter of a thin wire using air wedge. How do you test the plainness of a glass plate by forming an air wedge ?

Or

(b) What are Polaroid's ? List its application. Briefly explain with suitable example positive and negative crystals.

17. (a) Explain in detail the different operators in quantum mechanics.

Or

(b) Explain the following :

(i) Fermi level and its significance.

(ii) Microstates and Macrostates.

18. (a) (i) The intensity of sound increased to 100 times. Express it in change in decibels.

(ii) Give the significance of reverberation time.

Or

(b) Explain the phenomenon of magnetostriction. How will you produce high frequency sound waves with its help ?

19. (a) What is a photodiode ? Give its structure and working. Describe how photodiode can act as a photodetector.

Or

(b) Explain the following :

(i) Structure and working of LED.

(ii) Thermistors.

20. (a) (i) Explain any five application of optic fibre.

(ii) Outline the principle behind the propagation of light through an Optic fibre.

Or

(b) What is Josephson junction ? With necessary diagram explain I-V characteristics of a Josephson junction.

(5 × 10 = 50 marks)

C 83793 (Pages : 3) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2020

MA 19 200—DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*
Each question carries 5 *marks.*

1. Solve : $x\frac{dy}{dx} + y = x^3y^6$.

2. Solve : $\left(x^2 - 4xy - 2y^2\right)dx + \left(y^2 - 4xy - 2x^2\right)dy = 0$.

3. Solve : $y\left(\frac{dy}{dx}\right)^2 + (x - y)\frac{dy}{dx} - x = 0$.

4. Solve : $\left(D^3 + 3D^2 + 3D + 1\right)\ y = e^{-x}$.

5. Solve : $\left(D^2 - 4D - 5\right)y = 4\cos 2x$.

6. Solve by the method of variation of parameter $\frac{d^2y}{dx^2} + a^2y = \tan ax$.

7. Evaluate $\iint_R xy\,dA$ over the region R enclosed between $y = \frac{1}{2}x$, $y = \sqrt{x}$, $x = 2$ and $x = 4$.

8. Use a double integral to find the area of the region R enclosed between the parabola $y = \frac{x^2}{2}$ and the line $y = 2x$.

Turn over

9. Evaluate $\int_0^3 \int_0^{\sqrt{9-z^2}} \int_0^x xy\,dy\,dx\,dz$.

10. In what direction from $(3, 1, -2)$ is the directional derivative of $\phi(x, y, z) = x^2y^2z^4$ maximum and what is magnitude ?

11. Find the angle between the surfaces $xy^2z = 3x + z^2$ and $3x^2 - y^2 + 2z = 1$ at the point $(1, -2, 1)$.

12. Find the constants a, b, c so that $\bar{F} = (x + 2y + az)\,i + (bx - 3y - z)\,j + (4x + cy + 2z)\,k$ is irrotational. Find the scalar potential of $\bar{F}$.

13. If $\bar{F} = (3x^2 + 6y)\,i - 14yzj + 20\,xz^2k$ evaluate the line integral $\int_C \bar{F} \cdot d\bar{r}$ from $(0, 0, 0)$ to $(1, 1, 1)$ along the path C : $x = t, y = t^2, z = t^3$.

14. If $\bar{F} = (2x^2 - 3z)\,i - 2xyj - 4x\,k$, then evaluate $\iiint_V \nabla \cdot \bar{F}\,dV$, where V is bounded by the planes $x = 0, y = 0, z = 0$ and $2x + 2y + z = 4$.

15. Using Green's theorem in the plane to evaluate $\int_C (3x^2 - 8y^2)\,dx + (4y - 6xy)\,dy$ where C is the boundary of the region defined by $y = \sqrt{x}, y = x^2$.

(10 × 5 = 50 marks)

Part B

Answer **one** *full section from each question.*
Each question carries 10 *marks.*

16. (a) Solve $(y - x - 4)\,dy = (y + x - 2)\,dx$.

Or

(b) Find the orthogonal trajectories of the family of parabolas $y^2 = 4ax$.

17. (a) Solve $x^3 \frac{d^3y}{dx^3} + 3x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} + 8y = 65 \cos(\log x)$.

Or

(b) Solve $(2x+3)^2 \frac{d^2y}{dx^2} - (2x+3) \frac{dy}{dx} - 12y = 6x$.

18. (a) Evaluate $\int_0^a \int_{x^2/a}^{2a-x} xy \, dy \, dx$, by changing the order of integration.

Or

(b) Find the volume bounded by the xy-plane, the cylinder $x^2 + y^2 = 1$ and the plane $x + y + z = 3$.

19. (a) (i) Find the value of n, if $r^n \bar{r}$ is both solenoidal and irrotational when $\bar{r} = xi + yj + zk$.

(ii) If ϕ and ψ are scalar point functions, prove that $\phi \nabla \phi$ is irrotational and $\nabla\phi \times \nabla\psi$ is solenoidal.

Or

(b) (i) Find the values of the constants a, b, c so that $\bar{F} = (axy + bz^3)i + (3x^2 - cz)j + (3xz^2 - y)k$ may be irrotational. For these values of a, b, c, find also the scalar potential of $\bar{F}$.

(ii) If $\bar{r} = xi + yj + zk$ and $r = |\bar{r}|$, then prove that $\nabla^2 r^n = n(n+1) r^{n-2}$.

20. (a) Verify the divergence theorem for the function $\bar{F} = x^2 yi + x^2 zk + x^3 i$ over the cylindrical region S bounded by $x^2 + y^2 = a^2, z = 0, z = 6$.

Or

(b) Verify Stoke's theorem for $\bar{F} = (x^2 + y^2)i - 2xyj$ taken round the rectangle bounded by $x = \pm a, y = 0$ and $y = b$.

(5 × 10 = 50 marks)

C 5551 (Pages : 3) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2021

B.Tech.

EE 19 101—BASICS OF ELECTRICAL ENGINEERING

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*
Each question carries 5 *marks.*

1. Illustrate Kirchhoff's Voltage Law.
2. A circuit consist of four 50 W, 200 V lamps connected in parallel across a 200 V dc supply. Calculate the following (a) Resistance of the filament of each lamp ; and (b) Total power drawn from the mains
3. How do you represent a practical current source ?
4. Derive the expression for energy stored in a magnetic circuit.
5. State and explain Faradays laws.
6. Define self inductance and obtain an expression for the same.
7. Define R.M.S value and average value of an alternating quantity.
8. Show that the average power dissipated by an inductor over a cycle of ac is zero. Interpret the result.
9. Explain why three phase power is popular. Give its advantages.
10. Discuss the different type of motor.
11. Distinguish between single phase and three phase transformer.
12. Discuss the different losses in a transformer and how to minimize it.
13. List the various renewable energy sources.
14. Draw the block diagram of power system.
15. List the various advantage of wind energy.

(10 × 5 = 50 marks)

Turn over

Part B

Answer section (a) **or** *section (b) of each question.*
Each question carries 10 *marks.*

16. (a) Two resistance of 10 Ω and 40 Ω respectively are connected in parallel with each other. Another resistance of 10 Ω is connected in series with the combination. Calculate the respective d.c. voltage which should be applied across the whole circuit to pass 6A through the 10 Ω resistance in series with parallel combination.

Or

(b) With suitable example explain the solution of network equations by matrix methods.

17. (a) A mild steel ring of 30 cm mean circumference has a cross sectional are of 6 cm^2 and has a winding of 500 turns on it. The ring is cut through at a point so as to provide an air gap of 1mm in the magnetic circuit. It is found that a current of 4 A in the winding produces a flux density of 1 T in the air gap. Find (i) The relative permeability of the mild steel ; (ii) Inductance of the winding.

Or

(b) Find the inductance of an air cored solenoid having a diameter of 6 cm, length 40 cm and wound with 300 turns.

18. (a) Obtain an expression between current and voltge in an alternating current circuit consisting of resistance R and inductance L. Show that current lags behind the voltage. Define and explain reactance and impedance of an ac circuit.

Or

(b) Three impedances each of resistance 20 Ω and inductive reactance 15 Ω are connected in delta across a balanced 3Φ , 400 V a.c supply. Determine the line current, phase current, power factor and active power drawn from the mains.

19. (a) Describe the principle and working of an electric D.C motor. Explain what is meant by back emf and starting resisitance of a motor.

Or

(b) A 200 volt D.C motor draws 4 ampere current at start. Calculate the power wasted as heat when the motor makes 10 revolutions per second and draws a 3 ampere current. Calculate the emf and the current when the motor makes 20 revolutions per second.

20. (a) Explain in detail the principle and construction of a three phase induction motor. Explain its working. How does the variation of supply frequency affect the operation of induction motor ?

Or

(b) A 3-phase, 4 pole 50Hz induction motor runs at a speed of 1460 r.p.m. Determine the synchronous speed, percentage slip and the frequency of the. rotor current.

(5 × 10 = 50 marks)

C 5550 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2021

B.TECH.

EC 19 101—BASICS OF ELECTRONICS ENGINEERING

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*
Each question carries 5 *marks.*

1. Give a short account of metal film resistors and note its application.
2. List the advantages of electrolytic capacitors.
3. Briefly explain the principle of low power transformer.
4. With suitable example explain intrinsic and extrinsic semi conductors.
5. Explain the principle and construction of solar cell.
6. Explain the structure of PNP and NPN transistors.
7. With suitable example explain the simplification of Boolean expressions.
8. Convert the octal 527 into binary number.
9. State and explain De Morgan's law. Show that a NOR gate with inverted input is equivalent to an AND gate.
10. Draw the circuit diagram of BJT amplifier. What do you meant by half power frequencies.
11. Briefly explain the working principles of oscillators.
12. What is Barkhausen criterion for feedback oscillators ? List few advantages of negative feedback.
13. With the help of a neat diagram explain the working of an AM transmitter.
14. Compare AM and FM.
15. With a neat diagram explain the principle of light transmission through fiber.

(10 × 5 = 50 marks)

Turn over

Part B

Answer section (a) **or** *section (b) of each question.*
Each question carries 10 marks.

16. (a) With necessary diagram, explain the construction, working, rating and applications of electrolytic capacitors.

Or

(b) Explain the color coding associated with resistors. Illustrate with examples. Give the applications of various type of capacitors.

17. (a) Compare the characteristics of the three BJT configuration giving uses of each. Give the mechanism of current flow in an npn transistor.

Or

(b) Discuss in detail the principle of operation and input - output characteristics of common emitter configuration.

18. (a) Write an essay on logic gates. Why are they called so ? Give its applications.

Or

(b) What is a rectifier ? Explain the working of a full wave bridge rectifier. Derive its efficiency.

19. (a) What is an amplifier ? What is faithful amplification? Define current gain, voltage gain, and power gain of a C.E amplifier. Derive the expression.

Or

(b) List and explain the performance characteristics of an OPAMP. What are the basic OPAMP circuits ? Discuss its importance.

20. (a) Define modulation. With a neat sketch explain AM and FM. Derive modulation index.

Or

(b) Draw the block diagram for optical communication and explain each block. What are its advantages ?

(5 × 10 = 50 marks)

C 5549 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2021

B.Tech.

CE 19 101—BASICS OF CIVIL ENGINEERING

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*
Each question carries 5 *marks.*

1. List out the structural components of a residential building.
2. Explain transportation and water resource engineering.
3. List out the factors to be considered in the selection of site for a building.
4. List out the open space requirements for a building.
5. Write short note on site plan of a building.
6. Define plot area, plinth area, floor area and carpet area.
7. Explain the method of reciprocal levelling. When do you need it ?
8. List the various uses of contour maps.
9. Draw a neat sketch of Dumpy level and mark the salient features.
10. What are the properties of cement mortar ?
11. List out the advantages of RCC over PCC.
12. What is meant by curing of concrete ? Why it is necessary ?
13. List out the advantages of brick masonry over stone masonry.
14. Define safe bearing capacity of soil, and explain its importance in foundation design.
15. What are the functions of good foundation in buildings ?

(10 × 5 = 50 marks)

Turn over

Part B

Answer any **one** *full section from each question.*
Each question carries 10 *marks.*

16. (a) Explain in detail the different types of building according to NBC.

Or

(b) Describe in detail the contribution of civil engineering to the welfare of the society.

17. (a) Draw a rough sketch of the section of a simple storied building and mark the basic building components.

Or

(b) Explain the points to be considered while selecting the position of doors and windows in a building.

18. (a) What are the fundamental principles of surveying ? Explain briefly.

Or

(b) Write short notes on (a) Remote sensing ; and (b) Geographical Information System.

19. (a) State the important properties and uses of cement mortar.

Or

(b) What is R.C.C. ? Briefly write on desirable properties and uses of concrete.

20. (a) Explain different types of bonds used in brick masonry with sketches.

Or

(b) Explain the functional features of road, bridges and dam.

(5 × 10 = 50 marks)

C 5548 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2021

B.Tech.

ME 19 101—BASICS OF MECHANICAL ENGINEERING

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*
Each question carries 5 *marks.*

1. What is the effect of compression ratio on the thermal efficiency of Otto cycle ?
2. With help of p-V and T-S diagram explain the various processes involved in a Carnot cycle.
3. Derive an equation for the air standard efficiency of Otto cycle in terms of the engine compression ratio.
4. What is the concept of MPFI ?
5. Differentiate between SI and CI engine.
6. What are the advantages of belt drive over other drive ? What are the disadvantages ?
7. Why do we require CFC free refrigerants for refrigeration ? What are the ecological problems in using CFC refrigerants ?
8. Differentiate between impulse and reaction turbine.
9. What is function of air vessel in reciprocating pump ?
10. What is the difference between conventional and non conventional energy sources ?
11. What are the advantages and disadvantages of hydel power plant ?
12. List the nuclear power plants in India.
13. Explain closed die forging process with the help of neat sketch.
14. Discuss the effect of alloying elements to steel.
15. Define grinding. What are the practical applications of grinding ?

(10 × 5 = 50 marks)

Turn over

Part B

Answer any **one** *full section from each question.*
Each question carries 10 *marks.*

16. (a) 1 kg of air having an initial volume of 0.3 m^3 is heated at constant pressure of 3.2 bar until the volume is doubled. Find : (a) heat added, and (b) work done. Take c_p = 1.005kJ/kg.K, c_v = 0.718 kJ/kg.K.

Or

(b) 0.5 kg of air is compressed reversibly and adiabatically from 80 kPa, 60° C to 0.4 MPa, and is then expanded at constant pressure to the original volume. Calculate the heat transfer and work transfer for the whole path. Take R = 0.287 kJ/kg.K, c_p = 1.005 kJ/kg.K and c_v = 0.718 kJ/kg.K

17. (a) Explain the working principle of 4 stroke petrol engine with the help of neat sketch.

Or

(b) What is meant by gear train ? Explain epicyclic gear train.

18. (a) Explain the working principle of centrifugal pump.

Or

(b) What is the principle of working of vapour compression refrigeration system ?

19. (a) Draw the layout of a Diesel power plant and explain.

Or

(b) Explain the various types of renewable energy sources.

20. (a) What factors influence the selection of a material for an engineering application ?

Or

(b) What are the various operations that can be performed in a lathe ? Explain any two of them.

(5 × 10 = 50 marks)

C 5547 (Pages : 4) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2021

B.Tech.

EM 19 100—ENGINEERING MECHANICS

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*
Each question carries 5 *marks.*

1. Four forces equal to P, 2P, 3P and 4P are acting along four sides of a square ABCD taken in order. Find the characteristics of the resultant.
2. What is the concept of static indeterminacy ? Comment with a suitable example.
3. What is SI unit ? What is its importance ? Give few examples of commonly used SI units.
4. Briefly describe with suitable figure "Cone of Friction".
5. Distinguish between couple and torque.
6. Briefly comment on truss. Difference between plane truss and space truss.
7. Distinguish between centroid and center of gravity. Provide general equations.
8. Explain the analytical method for determining the centroid of composite areas.
9. What is the moment of inertia of a simple 'L' section ? Derive a generalised equation for the same.
10. Define the major differences between static and dynamic systems. Site real world examples for each.
11. With the help of mathematical relations define D' Alembert's principle.
12. Derive the equation for centroid of a rectangle.
13. What are the basic elements of a vibrating system ?
14. Write short note on the various terms used with SHM.
15. A 80 N weight is hung on the end of a helical spring and is set vibrating vertically. The weight makes 4 oscillations per second. Determine the stiffness of the spring.

(10 × 5 = 50 marks)

Turn over

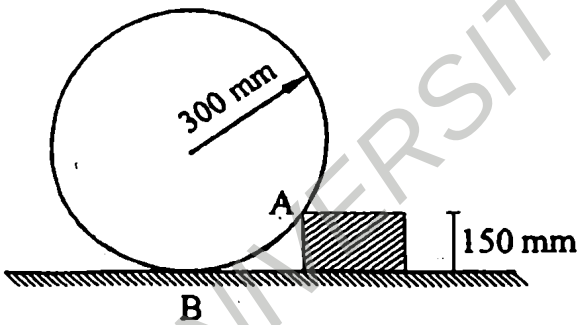
Part B

Answer **one** *full question from each section.*
Each question carries 10 *marks.*

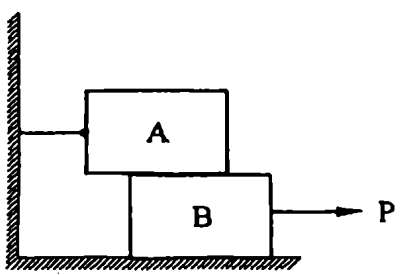
I. (a) Find the resultant and equilibrant of coplanar concurrent force systems. Use a detailed figure to define the force system.

Or

(b) A roller of radius 300 mm and a load of 1000 N is to be pulled over a rectangular block of height 150 mm as shown in figure. Determine : (i) The horizontal force required to be applied through the centre O ; (ii) The least force required to be applied through the centre O ; and (iii) The required horizontal force when it is applied through the top end of vertical diameter.

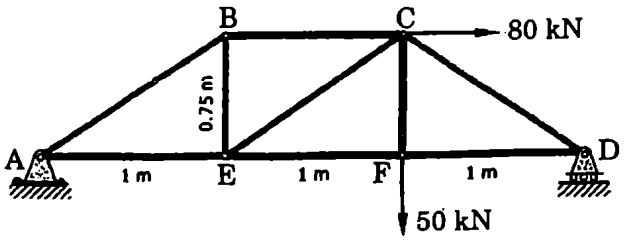


II. (a) Two blocks A and B of weights equivalent to 200N and 300N respectively. Find the force required to move block B. Assume the coefficient of friction for all surfaces to be 0.3.

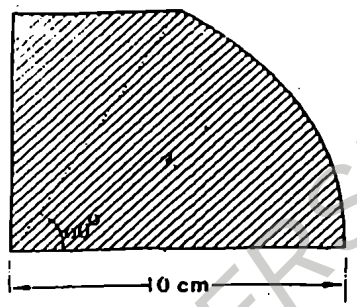


Or

(b) Compute the force in all members of the truss as shown in figure using method of joints.

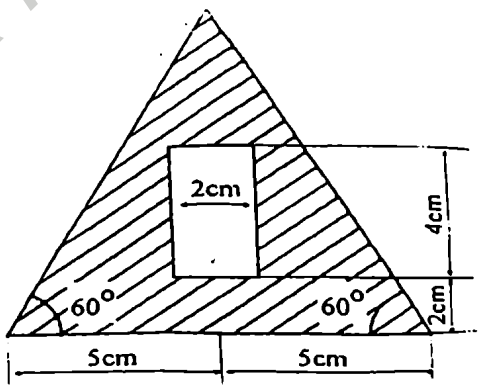


III. (a) Locate the centroid of the area as shown in figure.

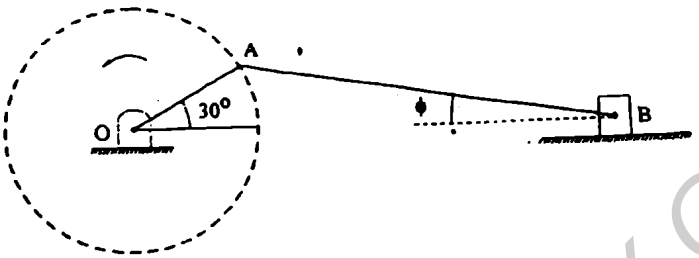


Or

(b) Calculate the moment of inertia of the shaded region as shown in figure with respect to the centroidal axes.



IV. (a) In the reciprocating engine mechanism as shown in figure, the crank OA rotates at a uniform speed of 300 r.p.m. The lengths of crank and connecting rod are 12 cm and 50 cm respectively. Find : (i) The angular velocity of the connecting rod AB ; and (ii) The velocity of piston when the crank makes an angle of 300 with horizontal.



Or

(b) An elevator has an upward acceleration of 1 m/s^2. What pressure will be transmitted to the floor of the elevator by a man weighing 600 N travelling in the elevator ? What pressure will be transmitted if the elevator has a downward acceleration of 2 m/s^2 ?

V. (a) A body moving with SHM has velocities of 10 m/s and 4 m/s at 2 and 4 m distance from the mean position. Find the amplitude and time period of the body.

Or

(b) A body is vibrating with SHM of amplitude 150 mm and frequency of 3 cps. Calculate the maximum velocity and acceleration of the body. Draw suitable diagram to specify each case.

(5 × 10 = 50 marks)

C 5546 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2021

B.Tech.

GS 19 100—ENGINEERING GRAPHICS

Time : Three Hours Maximum : 100 Marks

Answer **three** *questions from Part A and any* **two** *questions from Part B.*
All question carry equal marks.

Part A

1. (a) A line AB measures 100 mm. The projectors through its V.T and the end A are 40 mm apart. The end A is 30 mm above H.P and 20 mm in front of V.P. The V.T is 10 mm below H.P. Draw the projection of the line and determine H.T and inclination with H.P and V.P.

Or

(b) A pentagonal plane with a 30 mm side rests on the H.P on an edge such that surface is inclined at 45° to the H.P and the edge on which it rests is inclined at 30° to the V.P. Draw its projections.

2. (a) A cone, having a base with a 50 mm diameter and a 65 mm long axis, has one of its generators in the V.P and is inclined at 30° to the H.P. Draw its projections, when its apex being 10 mm above the H.P.

Or

(b) A cube with 45 mm long edges rests on H.P with vertical faces equally inclined to the V.P. It is cut by a section plane perpendicular to the V.P so that the true shape of the section is a regular hexagon. Draw the sectional top view and true shape of the section. Also determine the inclination of the section plane with the H.P.

3. (a) In a semicircular plate with a 140 mm diameter, a circular hole of largest size is made. The plate is then folded to form a cone. Draw the two views of the cone.

Or

(b) A hexagonal prism having base with a 30 mm side and 40 mm height is surmounted by a hemi-sphere such that the hemi-sphere is touching all the edges of the top base. Draw the isometric projection of the arrangement.

(3 × 20 = 60 marks)

Turn over

Part B

Answer any **two** *questions.*

4. (a) A square prism having a base with a 40 mm side and 60 mm long axis is resting on its rectangular face on the G.P with axis inclined at 30°to PP. A side of base nearer to the PP is 20 mm behind it and 20 mm to the left of the station point. The station point is 80 mm in front of PP and 70 mm above GP. Draw its perspective view.

   (b) Draw the three views of a hexagonal headed bolt of size M24. The length of the bolt is 80 mm and the thread length is 54 mm.

   (c) A cone with 60 mm base diameter and 70 mm long axis, rests on its base on HP. It is cut by an A.I.P passing through the midpoint of the axis such that the true shape of the section is an ellipse of largest major axis. Draw the projection of the truncated cone and the true shape of the section.

(2 × 20 = 40 marks)

C 5545 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2022

B.TECH.

CH 19 100—ENGINEERING CHEMISTRY

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*
Each question carries 5 *marks.*

1. Distinguish between temporary and permanent hardness?
2. Explain free radical polymerization mechanism.
3. What is glass transition temperature ? Explain any three factors affecting Tg.
4. Write the significance of the following properties of lubricants.

   (i) Flash and fire point ; and (ii) Corrosion stability.
5. What is biodiesel ? What are its advantages
6. What is knocking in IC engines ? How can it be prevented ?
7. Discuss the various applications of fullerenes.
8. What are the limitations of adopting green technologies ?
9. What are carbon nano-tubes ? Give types with respect to their structure.
10. Find out the e.m.f. of the cell and $Mg/Mg^{2+}_{(aq)} / Cd^{2+}_{(aq)} / Cd_{(s)}$ at 25°C if $Cd^{2+} = 6 \times 10^{-11}$ M and $Mg^{2+} = 1$ M. E^0 cell = 1.97 V.
11. What are the advantages of fuel cells ?
12. What is standard hydrogen electrode ? How is it used to measure the standard electrode potential.
13. Explain the mechanism of differential aeration corrosion.

Turn over

14. Give the Pilling-Bedworth rule and its significance.

15. What is galvanizing ? Explain the process.

(10 × 5 = 50 marks)

Part B

Answer **one** *full question from each section.*
Each carries 10 *marks.*

16. a) How demineralization of water can be done by ion-exchange ?

Or

b) Give the classification of conducting polymers and write the mechanism of conduction in them.

17. a) Discuss the mechanism of lubricants.

Or

b) What is reforming of petroleum ? Give the reactions involved in reforming.

18. a) How are nanomaterials classified ? Describe any two in detail.

Or

b) Discuss any five principles of green chemistry.

19. a) What is glass electrode ? How is it constructed ? Describe the experimental determination of pH of a solution using glass electrode.

Or

b) Describe the construction and the chemistry of working of a Ni-Cd storage battery.

20. a) Explain the electrochemical mechanism of rusting of iron in humid atmosphere. Mention any four factors that affect the rate of corrosion.

Or

b) What is electroplating ? Explain how the following factors influence the nature of electrodeposit, (i) Metal-ion concentration ; and (ii) Current density.

(5 × 10 = 50 marks)

C 5544 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE (2019 SCHEME) EXAMINATION, APRIL 2021

B.Tech.

PH 19 100—ENGINEERING PHYSICS

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*

Each question carries 5 *marks.*

1. Explain the term coherence length and coherence time and its role in interference.
2. Explain the colours of thin film viewed with white light.
3. What are Polaroid's ? Give its applications ?
4. What are the postulates of Quantum Mechanics ?
5. Explain the term energy and momentum operators.
6. What is meant by wave function? Write its normalization condition.
7. Obtain the relation between path difference and phase difference in wave motion.
8. What are the limitations of Sabine's formula ?
9. Discuss the methods to detect ultrasonic sound.
10. Distinguish between a photodiode and a LED.
11. What are the characteristics of an optic fibre ?
12. Explain the propagation of light through step-index fibre.
13. Explain the terms stimulated emission and population inversion in laser.
14. What are the advantages of holograms over photographic images ?
15. Discuss the use of hologram for image storage.

(10 × 5 = 50 marks)

Part B

Answer section (a) **or** *section* (b) *of each question.*
Each question carries 10 *marks.*

16. (a) Discuss the theory of plane transmission grating and also derive the expression sin $\theta = nN\lambda$. Where the symbols have usual meanings.

Or

(b) (i) With a neat diagram explain Fraunhofer diffraction at single slit.

(ii) Define resolving power of grating.

17. (a) Deduce Schrödinger time dependent equation using the operators for position and momentum

Or

(b) (i) What are the important postulates of Maxwell-Boltzmann statistics ?

(ii) Show the variation of Fermi function with energy.

18. (a) (i) A string when stretched by a weight of 4 kg. gives a note of frequency 256 Hz. What weight will produce a frequency twice the above frequency ?

(ii) Derive the one dimensional wave equation and hence obtain the laws of transverse vibrations of a stretched string.

Or

(b) (i) Intensity of sound reduces to 10'6 of its initial value in a time RT called reverberation time. Express this definition in decibel.

(ii) Explain the significance of reverberation.

19. (a) Explain the principle and working of thermal detectors. With a neat circuit diagram discuss the measurement of temperature using resistance thermometer.

Or

(b) (i) Calculate the fibre acceptance angle for the step-index fibre from the following data ; $n_1 = 1.53$; $n_2 = 1.50$; $n_a = 1$.

(ii) Draw the block diagram of optic fibre communication system. Explain its various functional blocks.

20. (a) Explain the essential requirements for producing laser action. Outline how these requirements are usually obtained.

Or

(b) Explain the principle and working of Helium - Neon laser. Write a note on holograms.

(5 × 10 = 50 marks)

C 5543 (Pages : 3) Name.....

Reg. No.....

SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE [2019 SCHEME] EXAMINATION, APRIL 2021

B.Tech.

MA 19 200—DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **ten** *questions.*
Each question carries 5 *marks.*

1. Solve : $\frac{dy}{dx} + \frac{x}{1-x^2} y = x\sqrt{y}$.

2. Solve : $(3x^2 + 6xy^2)\,dx + (6x^2y + 4y^3)\,dy = 0$.

3. Solve : $x^2\left(\frac{dy}{dx}\right)^2 + xy\frac{dy}{dx} - 6y^2 = 0$.

4. Solve : $(D^2 - 4D + 1)\,y = e^{2x} \sin 2x$.

5. Solve : $(D^3 - 3D - 2)\,y = x^2$.

6. Solve by the method of variation of parameters $\frac{d^2y}{dx^2} + 4y = \text{cosec } 2x$.

7. Evaluate $\int_0^1 \int_0^{\sqrt{1+x^2}} \frac{dy\,dx}{1+x^2+y^2}$.

8. Change the order of integration in $\int_0^a \int_0^x \frac{x\,dy\,dx}{x^2+y^2}$ and hence evaluate the same.

9. Evaluate $\int_0^3 \int_0^{\sqrt{9-z^2}} \int_0^x xy\,dy\,dx\,dz$.

10. Find the directional derivative of $f(x, y, z) = x^2y - yz^3 + z$ at the point (1, – 2, 0) in the direction of the vector $\bar{a} = 2i + j - 2k$.

11. Find div $\overline{F}$ and curl $\overline{F}$ where $\overline{F} = \text{grad}\left(x^3 + y^3 + z^3 - 3xyz\right)$.

12. Find the angle between the tangent planes to the surfaces $x \log z = y^2 - 1$ and $x^2y = 2 - z$ at the point (1, 1, 1).

13. If $\overline{F} = \left(3x^2 + 6y\right)i - 14yzj + 20xz^2k$ evaluate the line integral $\int_C \overline{F} \cdot d\overline{r}$ from (0, 0, 0) to (1, 1, 1) along the path $c : x = t, y = t, z = t$.

14. Evaluate $\iint_S \overline{F} \cdot \hat{n} dS$ where $\overline{F} = 18zi - 12j + 3yk$ and S is the surface of the plane $2x + 3y + 6z = 12$ in the first Octant.

15. Using Green's theorem in the plane evaluate $\int_C \left(2xy - x^2\right)dx + \left(x^2 + y^2\right)dy$ where C is the boundary of the region enclosed by $y = x^2$ and $y^2 = x$.

(10 × 5 = 50 marks)

Part B

Answer **one** *full section from each question.*
Each question carries 10 *marks.*

16. (a) Solve $(3y + 2x + 4)\,dx - (4x + 6y + 5)\,dy = 0$.

Or

(b) Find the orthogonal trajectories of the family of parabolas $y = ax^2$.

17. (a) Solve $x^3 \frac{d^3y}{dx^3} + 3x^2 \frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = \sin(\log x)$.

Or

(b) Solve $(3x + 2)^2 \frac{d^2y}{dx^2} + 3(3x + 2)\frac{dy}{dx} - 36y = 3x^2 + 4x + 12$.

18. (a) Find the smaller of the areas bounded by the ellipse $4x^2 + 9y^2 = 36$ and the straight line $2x + 3y = 6$.

Or

(b) Find the volume bounded by the cylinder $x^2 + y^2 = 4$ and the planes $y + z = 4$ and $z = 0$.

19. (a) If $\overline{r} = xi + yj + zk$ and $r = |\overline{r}|$ then prove the following (i) $\nabla^2\left(r^n\right) = n(n+1)r^{n-2}$; (ii) $\text{div}\left(\frac{\overline{r}}{r^3}\right) = 0$.

Or

(b) (i) If $\overline{F} = (y^2 - z^2 + 3yz - 2x)i + (3xz + 2xy)j + (3xy - 2xz + 2z)k$ show that $\overline{F}$ is both solenoidal and irrotational. Find also the scalar potential of $\overline{F}$.

(ii) Find the constants a and b so that the surface $5x^2 - 2yz - 9x = 0$ and $ax^2y + bz^3 = 4$ may cut orthogonaly at the point (1, – 1, 2).

20. (a) Verify Stoke's theorem for $\overline{F} = (\sin x - y)\,i = \cos xj$ taken round the triangle whose vertices are (0, 0), (π/2, 0) and $\left(\frac{\pi}{2}, 1\right)$.

Or

(b) Verify divergence theorem for $\overline{F} = x^2i + 3j + yzk$ taken over the cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0$ and $z = 1$.

(5 × 10 = 50 marks)