

III-SEM./ELECTRICAL/ ETE/MECHANICAL /AUTO/AE & IE/CSE/IT
/EEE/MECH(IND INTG)/ ELECTRICAL(INST &CTRL)/ 2021(W)
BST-301 ENGINEERING MATHEMATICS -III

Full Marks: 80

Time- 3 Hrs

Answer any five Questions including Q No.1& 2
Figures in the right hand margin indicates marks

1. Answer **All** questions 2 x 10

- a. State Rouché's Theorem.
- b. Solve $(D^2 + 1)y = 0$
- c. Frame a partial differential equation for the function
 $z = (x - a)^2 + (y - b)^2$
- d. What is Gamma function? Find $\Gamma(-3.5)$
- e. Find $L^{-1}\left(\frac{3}{s+3}\right)$
- f. Define even and odd functions with examples.
- g. Write Newton Raphson formula to find $\sqrt{N}$.
- h. Evaluate $\Delta^2(e^x)$
- i. State Newton Cotes Quadrature Formula.
- j. Define Rank of a matrix.

2. Answer **Any Six** Questions 5X6

- a. Find the root of the equation $x^3 - x - 1 = 0$ correct to three places of decimal using Bisection Method.
- b. Find the Laplace Transform of
 $f(t) = \begin{cases} t, & 0 \leq t < 3 \\ 5, & t \geq 3 \end{cases}$
- c. State the Convergence condition of Fourier Series.
Find a_0 of $f(x) = e^x$ in $-\pi < x < \pi$
- d. Evaluate $\int_1^3 \frac{1}{x} dx$ using Trapezoidal Rule taking $h = 0.5$
- e. Find $f(2.8)$ using Newton's Backward Interpolation Formula

x	0	1	2	3
F(x)	1	2	11	34

- f. Solve $(D^2 + 3D + 2)y = xe^x \sin x$
- g Find the rank of the matrix $\begin{pmatrix} -1 & -2 & 3 \\ 6 & 12 & 6 \\ 5 & 10 & 5 \end{pmatrix}$ by Row reduced Echelon form.
- 3 i) Find the Fourier Series of $f(x) = x + x^2$ in $(-\pi, \pi)$ 6
- ii) Solve $(D^2 - 10D + 25)y = 0$ 4
- 4 i) Check the consistency and solve by Matrix method 5
 $2x+y+z=5$
 $x+y+z=4$
 $x-y+2z=1$
- ii) Evaluate $\int_2^6 \frac{1}{1+x^3} dx$ using Simpson's $\frac{1}{3}rd$ rule and taking $h=1$ 5
- 5 i) Solve the following partial differential equation 5
 $x(y-z)p + y(z-x)q = z(x-y)$
- ii) Find $L(t \sin 3t)$ 5
- 6 i) Solve by Transform Method 6
 $\frac{d^2x}{dt^2} - 2\frac{dx}{dt} + x = e^t$ with $x = 2, \frac{dx}{dt} = -1$ at $t = 0$
- ii) Solve $(D^2 - 1)y = x^2e^x$ 4
- 7 i) Using Interpolation estimate the output of a factory in 1986 from the following data 5
- | | | | | |
|----------------------|------|------|------|------|
| year | 1974 | 1978 | 1982 | 1990 |
| Output in 1000 tones | 25 | 60 | 80 | 170 |
- ii) Find the Inverse Laplace Transform of $L^{-1}\left(\log \frac{s^2+1}{s(s+1)}\right)$ 5

III-SEM./ MECH/MECH(IND INTG)/AUTO/ 2021(W)OLD
MET-301/MET321 STRENGTH OF MATERIAL

Full Marks: 80

Time- 3 Hrs

Answer any five Questions including Q No.1& 2
Figures in the right hand margin indicates marks

1. Answer **All** questions 2 x 10
 - a. Define poisson's ratio.
 - b. Define shear force and bending moment diagram.
 - c. What is cantilever beam with example?
 - d. Define torsion.
 - e. What is the difference between stress and strain?
 - f. What is temperature stress? Write its formula.
 - g. What do you mean by column?
 - h. Define principal stress.
 - i. State Hooke's law.
 - j. Define section modulus.

2. Answer **Any Six** Questions 5X6
 - a. Show diagrammatically different types of beams and loads.
 - b. What are assumptions taken while deriving bending equations under theory of simple bending?
 - c. Derive expressions for hoop stress and longitudinal stress in case of thin cylindrical shell.
 - d. A simply supported beam of length 6m carries point load of 3KN and 6KN at distances of 2m and 4m from the left end. Draw the shear force and bending moment diagram for the beam.
 - e. The principal stresses at a point across two perpendicular planes are 75MN/m^2 (tensile) and 35MN/m^2 (tensile). Find the normal tangential stresses and the resultant stress and its obliquity on a plane at 20° with the major principal plane.
 - f. A solid shaft of 150mm diameter is used to transmit torque. Find the maximum torque transmitted by the shaft if the maximum shear stress induced to the shaft is 45N/mm^2
 - g. What are the assumptions of torsion equation?
 - h. A rectangular beam 200mm deep and 300mm wide is simply supported over a span of 8m. what uniformly distributed load per metre the beam may carry, if the bending stress is not to exceed 120N/mm^2

- 3 Define buckling load, state formula for buckling load in column with various end conditions with diagram. 10
- 4 Prove the relation $M/I = \sigma/y = E/R$ 10
 Where M=Bending moment
 σ = Bending stress in a fibre at distance y from the neutral axis
 I= Moment of inertia
 E= young's modulus
 And R= radius of curvature
- 5 A cantilever of length 2.0m carries a uniformly distributed load of 2kN/m length over the whole length and a point load of 3KN at the free end. Draw the S.F and B.M diagrams for the cantilever. 10
- 6 At a point in a strained material the principal stresses are 100N/mm^2 (tensile) and 60N/mm^2 (compressive). Determine the normal stress, shear stress and resultant stress on a plane inclined at 50° to the axis of major principal stress. Also determine the maximum shear stress at the point. 10
- 7 Derive the relation between three elastic constant. 10

III-SEM./ Mechanical Engg./MECHANICAL(IND INTG)/AUTO/ 2021(W)OLD
MET-322/MET-302 Engineering material

Full Marks: 80

Time- 3 Hrs

Answer any five Questions including Q No.1& 2
Figures in the right hand margin indicates marks

1. **Answer All questions** 2 x 10
 - a. Classify the engineering material.
 - b. What is point defect?
 - c. What is line defect ?
 - d. State the application of ceramic.
 - e. What is heat treatment?
 - f. What is slip?
 - g. Name any two non-ferrous metal and two ferrous metal.
 - h. What is elastomers?
 - i. What is hardenability of steel?
 - j. Write down uses of stainless steel.
2. **Answer Any Six Questions** 5X6
 - a. Describe mechanical properties of materials.
 - b. State various causes of edge dislocation and screw dislocation.
 - c. State the composition and properties of Duralimin and Y-alloy.
 - d. Explain the different types of line defects,
 - e. What are classification, composition properties and uses of copper base spring material.
 - f. Explain fiber reinforced composites with their application.
 - g. Differentiate between thermosetting and thermoplastic polymers.
 - h. Explain surface hardening heat treatment process.
3. Describe the composition, properties and uses of copper base bearing material and tin base bearing material. 10
4. Explain iron-carbon equilibrium diagrams and show the micro-constituents of iron and steel in different phase. 10
5. Explain the following heat treatment process 10
 - (i) Normalizing
 - (ii) Annealing
6. What is elastomers, write down the properties and application of thermosetting and thermoplastic polymers. 10
7. What is the purpose of painting? Explain methods of industrial painting. 10

3th SEM./MECH/MECH(IND INTG)/ 2021(W) OLD
MET-303 Thermal engineering-1

Full Marks: 80

Time- 3 Hrs

Answer any five Questions including Q No.1& 2
Figures in the right hand margin indicates marks

1. Answer **All** questions 2 x 10
 - a. Define properties and its different type.
 - b. What do you understand by the concept of continuum?
 - c. Define pressure. State its unit.
 - d. What is radiation type heat transfer?
 - e. What is meant by renewable energy sources?
 - f. Write the first law of thermodynamics for change of states.
 - g. Write the efficiency of heat engine.
 - h. Define entropy.
 - i. Define sensible heat and latent heat.
 - j. State the Guy Lussac's equation?
2. Answer **Any Six** Questions 6 x 5
 - a. Explain the different equilibriums in thermodynamics.
 - b. Explain the quasistatic process.
 - c. Derive the COP of heat pump and refrigerator by applying the 2nd law of thermodynamics.
 - d. Apply the steady flow energy equation in turbine and compressor.
 - e. If the specific volume of wet steam at 15bar is $0.125 \text{ m}^3/\text{kg}$, then find the dryness fraction of steam.
 - f. Derive the expression for the work-done for Polytropic process?
 - g. Explain the limitations of first law of thermodynamics.
3. Give the detailed expression for steady flow processes by applying the first law. 10
4. In a gas turbine, gas enters at the rate of 10 kg/s with a velocity of 50 m/s and enthalpy of 920 kJ/kg and leaves the turbine with a velocity of 170 m/s and enthalpy of 400 kJ/kg . Loss of heat to the surrounding is 25 kJ/kg . Assume for gas $R=0.285 \text{ kJ/kgK}$, $c_p=1.005 \text{ kJ/kgK}$ and inlet conditions to be 100 kPa and 27°C . Determine the power output of the turbine and diameter of inlet pipe. 10

5 A refrigeration plant operates as a reversed Carnot heat engine cycle. Store is to be maintained at a temperature of -5°C . Atmospheric temperature is 25°C . If the heat transfer from the store to the cycle is at the rate of 5kW , then calculate the power required to drive the plant. 10

6 A mass of 8kg gas expands according to the law $pv^{1.2}=\text{constant}$. Initial pressure is 1000kPa and initial volume is 1m^3 . Final pressure is 5KPa . If the specific internal energy of the gas decreases by 40kJ/kg , then find the total value of heat transfer. 10

7 Write the short notes on the following:
(a) Dalton's law of partial pressure
(b) Ideal and Real gas
(c) Dryness fraction
(d) Open and Closed system 10

**III-SEM/MECHANICAL/AUTO/AERO/DIP IN MECH/MECH(PROD)
/MECH(MAINT)/MECH(IND INTG)/MECH(SWICH)/ 2021(W)**
TH-1 Production Technology

Full Marks: 80

Time- 3 Hrs

Answer any **FIVE** Questions including **Q No.1&2**
Figures in the right-hand margin indicates marks

- | | | |
|----|--|--------|
| 1. | Answer ALL questions | 2 x 10 |
| | a. What is metal forming? | |
| | b. Classify the welding process. | |
| | c. Name any four types of welding defects. | |
| | d. What do you mean by reusability of moulding sand? | |
| | e. What is meant by machining allowance in pattern making? | |
| | f. State the steps in core preparation. | |
| | g. Define sintering process. | |
| | h. What is trimming operation in press work? | |
| | i. Why jigs are needed in production process? | |
| | j. Define casting process. | |
| 2. | Answer Any SIX Questions | 5X6 |
| | a. Compare Plate fixture with Angle-plate fixture. | |
| | b. Describe briefly about progressive dies with a neat sketch. | |
| | c. Explain Compacting process in press work. | |
| | d. What do you mean by a hanging core? Explain briefly. | |
| | e. Differentiate between TIG & MIG welding process. | |
| | f. Discuss about different types of rolling process. | |
| | g. State the need of using flux in welding. | |
| 3 | Describe Electric Arc Welding Process with neat sketch. | 10 |
| 4 | Discuss the working principle of Cupola Furnace. | 10 |
| 5 | Explain about different non-destructive tests carried out to detect casting defects. | 10 |
| 6 | Explain briefly the difference between Jigs with Fixtures. | 10 |
| 7 | Discuss briefly about the different secondary processes for producing components using powder metallurgy techniques. | 10 |

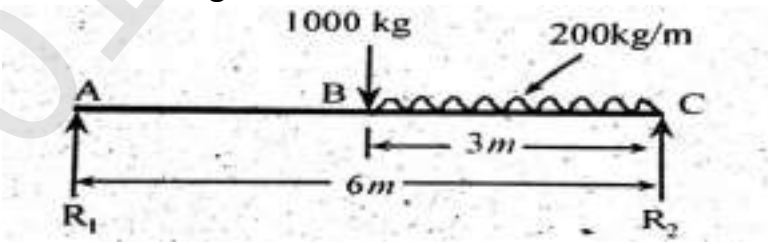
**III-SEM./MECH/AUTO/AERO/DIP IN MECH
/MECH(PROD/MECH(MAINT) /MECH(IND INTG) /
MECH(SWITCH)/ 2021(W)
TH-II Strength of Materials**

Full Marks: 80

Time- 3 Hrs

Answer any **FIVE** Questions including **Q No.1&2**
Figures in the right-hand margin indicates marks

1. Answer **ALL** questions 2 x 10
 - a. Define Stress.
 - b. State the Hook's Law.
 - c. Write down the expression for Strain Energy.
 - d. Define Hoop stress.
 - e. What do you understand by Principal Stresses?
 - f. Write the significance of Mohr's Circle.
 - g. State different types of beams.
 - h. What is pure bending?
 - i. Explain Crippling Load.
 - j. Define shaft.

2. Answer **Any SIX** Questions 5X6
 - a. State the assumptions made in theory of bending.
Find the reactions of simply supported beam when a point load of 1000 kg and a uniform distributed load of 200 kg/m is acting on it as shown in figure below:

 - b.
 - c. Explain Temperature stress and derive its expression.
 - d. Derive the torsion equation for a solid circular shaft.
A circular bar is subject an axial pull of 120 kN. If the maximum intensity of shear stress on any oblique plane is not to exceed 55 MN/m², find the diameter of the bar.
 - e.

- f. Find the generalized equation for Shear Force & Bending Moment of a simply supported beam with Uniformly Distributed Load.
A steel rod 22mm in diameter and 1.5meters long is subjected to an
- g. axial pull of 35 kN. Find i) The intensity of stress, ii) The strain & Elongation. Take $E=2 \times 10^5 \text{ N/mm}^2$
- 3 Derive the expression for Hoop Stress & Hoop Strain for thin spherical shells. 10
- 4 Find out the expression for Section Modulus for a i) Rectangular Section, ii) Hollow Rectangular Section, iii) Circular Section & iv) Hollow Circular Section. 10
- 5 Derive the relationship between the three modulus (Young's, Bulk & Shear). 10
- 6 The principal stresses at a point in a bar are 150 N/mm^2 (tensile) and 80 N/mm^2 (compressive). Determine the resultant stress in magnitude and direction on a plane inclined at 60° to the axis of the major principal stress. Also, find the maximum intensity of shear stress in the material at that point. 10
- 7 Derive the formulae for Crippling Load under various end conditions. 10

**3rd SEM./MECH/AUTO/AERO/DIP IN MECH/MECH(PROD)
/MECH(MAINT)/MECH(IND INTG)/MECH(SWITCH) - 2021(W)**

Th3- Engineering Materials

Full Marks: 80

Time- 3 Hrs

Answer any **FIVE** Questions including **Q No. 1 & 2**
Figures in the right-hand margin indicates marks

1. Answer **ALL** questions 2 x 10
 - a. Define Porosity.
 - b. What is Mild Steel?
 - c. Define unit cell.
 - d. What is the significance of phase diagram?
 - e. State two properties of spring materials.
 - f. Why heat treatment is needed?
 - g. State two characteristics of Duralumin.
 - h. Define polymerization.
 - i. Explain composite materials.
 - j. What is the function of bearing?

2. Answer **Any SIX** Questions 5x6
 - a. What is Spring? Discuss about different spring materials.
 - b. Explain Frankel Defect with figure.
 - c. Discuss about any two microconstituents of Iron & Steel.
 - d. Classify Composite materials. Discuss about Dispersion-strengthened Composites.
 - e. State the effects of adding Nickel and Molybdenum in steel as alloying elements.
 - f. Discuss about different bearing materials.
 - g. Compare thermoplastic with thermosetting plastics.

3. Discuss about any four types of mechanical properties of engineering materials. 10

4. Discuss about various properties of plastic. 10

5. What is Tool Steel? Classify it and state its properties with composition. 10

6. Draw Fe-C phase diagram. Explain about different phase transformations. 10

7. Explain about different crystal structures. 10

**3rd Sem./MECH/AUTO/AERO/DIP IN MECH/ MECH(PROD)/
MECH(MAINT)/ MECH(IND INTG)/ MECH(SWITCH)/ 2021(W)**
Th4 Thermal Engg.-1

Full Marks: 80

Time- 3 Hrs

Answer any five Questions including Q No.1& 2
Figures in the right hand margin indicates marks

1. Answer **All** questions 2 x 10
 - a. Define Point function and Path function.
 - b. What is mechanical equivalent of heat?
 - c. Define the Zeroth law of thermodynamics.
 - d. Explain the Clausius statement of 2nd law of thermodynamics.
 - e. State the Boyle's law and Charles's law.
 - f. Define enthalpy.
 - g. Define Piston speed and state its formula.
 - h. Draw the P-V and T-S diagram of Otto cycle.
 - i. Define Cetane number and Octane number.
 - j. What is meant by Free Expansion?

2. Answer **Any Six** Questions 5X6
 - a. Explain the Thermodynamic systems.
 - b. Derive the steady flow energy equation.
 - c. Differentiate between SI and CI engine.
 - d. Classify and explain the different types of fuel.
 - e. Derive the relationship between C_p , C_v and R .
 - f. Define COP. Derive the relation between COP of Refrigerator and COP of Heat Pump.
 - g. An ideal gas at 30°C and 1bar is compressed adiabatically from 5m³ to 1m³. Find the temperature, pressure and work done. Take $\gamma=1.4$

- 3 Derive the efficiency of Otto cycle with P-V and T-S diagram. 10
- An ideal diesel cycle operates within the temperature limits of 1700K and 300K and with a compression ratio of 16. Determine the
- 4 (a) pressure and temperature at each point in the cycle 10
 (b) thermal efficiency of the engine
 (c) mean effective pressure
- Air flows steadily at the rate of 1kg/s through an air compressor entering at 7m/s velocity, 100kPa pressure and specific volume of 0.95m³/kg and leaving at 5m/s, 700kPa and 0.19m³/kg. The difference in internal energy between outlet and inlet is 90kJ/kg. Cooling water absorbs heat from the air at the rate of 60kW. Calculate
- 5 (a) rate of work input 10
 (b) ratio of inlet and outlet pipe diameter
- 6 (a) What is the first law of thermodynamics? 10
 (b) Derive the expression for the work done for an Isothermal process.
- 7 Explain the working principle of 2 Stroke and 4 Stroke SI engine with neat sketch. 10

3rd Sem. Common 2021(W)

Th-5 Environmental Studies

Full Marks: 80

Time- 3 Hrs

Answer any five Questions including Q No.1& 2
Figures in the right hand margin indicates marks

1. Answer **All** questions 2 x 10
 - a. Define acid rain.
 - b. What is ecological succession?
 - c. What do you mean by soil erosion?
 - d. Define genetics and species.
 - e. Mention any two causes of marine pollution.
 - f. Define environment.
 - g. What is mortality?
 - h. What do you mean by sustainable development?
 - i. What leads to conflicts over water?
 - j. Define water pollution.
2. Answer **Any Six** Questions 6 x 5
 - a. Define and explain food chain with at least one example.
 - b. Explain the changes caused by modern agriculture.
 - c. Explain Biodiversity at National level.
 - d. Give a brief note on ozone layer depletion along with its consequences.
 - e. Discuss in brief 'Human Rights'.
 - f. Discuss the needs of public awareness towards environment.
 - g. Explain cyclone disaster management.
3. Explain the effects of mine extraction on environment and tribal people. 10
4. Explain different threats to biodiversity. 10
5. Describe forest ecosystem. 10
6. Write down the causes, effects and controlling measures of soil pollution. 10
7. a. Urban problems related to energy. 5
b. Family welfare program. 5